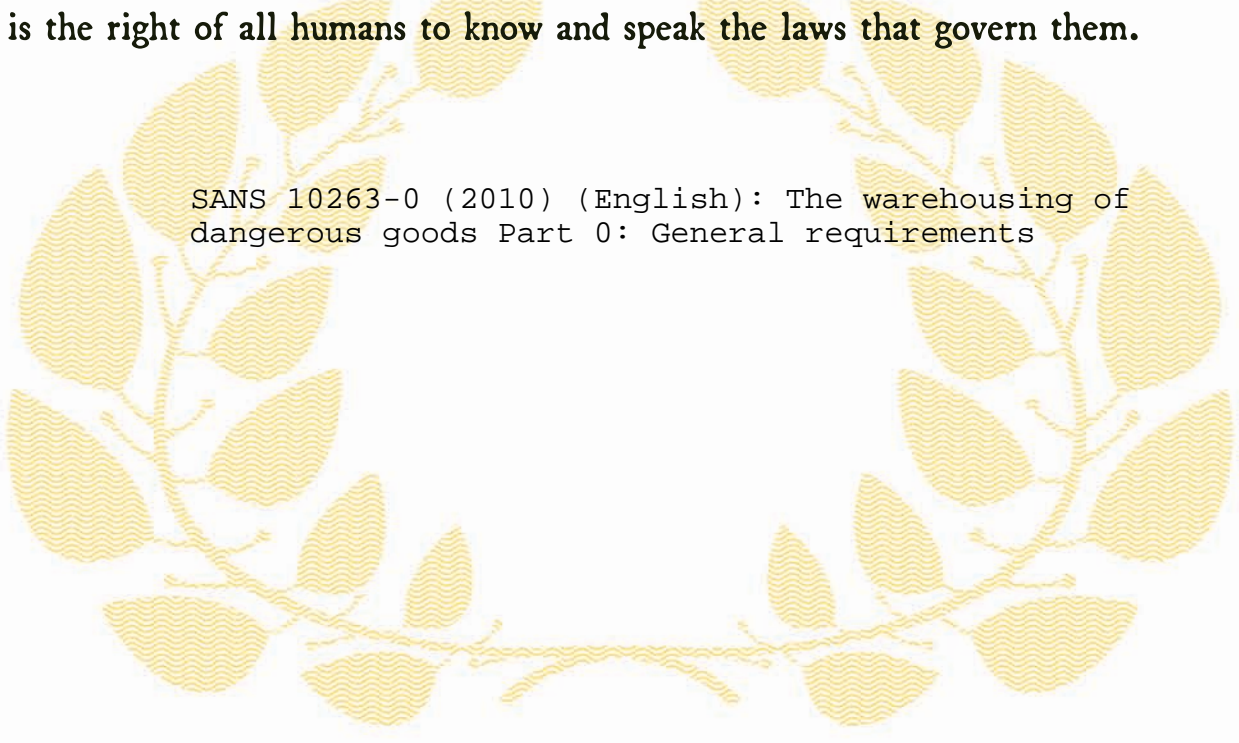




Republic of South Africa

EDICT OF GOVERNMENT

In order to promote public education and public safety, equal justice for all, a better informed citizenry, the rule of law, world trade and world peace, this legal document is hereby made available on a noncommercial basis, as it is the right of all humans to know and speak the laws that govern them.



SANS 10263-0 (2010) (English): The warehousing of dangerous goods Part 0: General requirements



BLANK PAGE



ISBN 978-0-626-23987-9

SANS 10263-0:2010

Edition 1.1

SOUTH AFRICAN NATIONAL STANDARD

The warehousing of dangerous goods

Part 0: General requirements

SANS 10263-0:2010
Edition 1.1

Table of changes

Change No.	Date	Scope
Amdt 1	2010	Amended to correct the legend to table E.1.

Foreword

This South African standard was approved by National Committee SABS SC 1060D, *National committee for standards for dangerous goods including hazardous chemical substances and dangerous goods waste – Storage: Design and operation*, in accordance with procedures of the SABS Standards Division, in compliance with annex 3 of the WTO/TBT agreement.

This document was published in July 2010.

This document supersedes SANS 10263-0:2009 (edition 1).

In 3.13 and 6.2.1(d)2 mention is made of a Safety Data Sheet. In South Africa safety data sheets are regulated by the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

In 5.1.2 and 12.8.2.2 mention is made of relevant legislation and regulations applicable to explosives. In South Africa this means the

- Explosives Act, 1956 (Act No. 26 of 1956) (as amended).

In 5.1.2 and 12.8.10.1 mention is made of relevant legislation and regulations applicable to radioactive material. In South Africa this means the

- Hazardous Substances Act, 1973 (Act No. 15 of 1973) (as amended),
- National Nuclear Regulator Act, 1999 (Act No. 47 of 1999), and
- Nuclear Energy Act, 1999 (Act No. 46 of 1999).

In 5.5.2, 8.1.1, 8.8.1.2, 10.1.1(c) and 10.2.2.1 reference is made to national building regulations. In South Africa, this means the National Building Regulations and Building Standards Act, 1977 (Act No. 103 of 1977).

In 5.9 and 18.1.1.1(b) mention is made of relevant national regulations and statutory provisions dealing with the prevention of pollution. In South Africa this means the

- Air Quality Act, 2004 (Act No. 39 of 2004),
- Environment Conservation Act, 1989 (Act No. 73 of 1989), and
- National Water Act, 1998 (Act No. 36 of 1998) (as amended).

In 8.1.1(b) mention is made of national regulations and statutory provisions dealing with the workplace environment. In South Africa this means the Environmental Regulations for Workplaces of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

In 8.16.1 mention is made of relevant national legislation with regard to the construction of rail sidings. In South Africa this is regulated by the Railway Safety Regulator in terms of the National Railway Regulations Act, 2002 (Act No. 16 of 2002).

In 11.4.1.9 mention is made of the national authority that approves the organization that issues certificates to drivers of fork-lift trucks with a capacity of 750 kg or more. In South Africa, this is the Chief Inspector of the Department of Labour.

In 12.8.1.3 mention is made of the licence to keep or supply dangerous substances. In South Africa this licence is governed by the Hazardous Substances Act, 1973 (Act No. 15 of 1973).

In 12.8.10.1 mention is made of relevant national legislation and regulations. In South Africa this means the Nuclear Act, 1993 (Act No. 131 of 1993).

In 12.8.10.2 mention is made of the national authority for nuclear safety. In South Africa this means the Council for Nuclear Safety.

In 12.8.10.4 mention is made of the national nuclear energy authority. In South Africa this means the Atomic Energy Corporation of South Africa.

In 12.13.1.4 mention is made of statutory regulations to be followed when an employee has been contaminated with a dangerous substance. In South Africa the regulations are given in the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993).

In 14.2.2 mention is made of the national department that deals with labour issues. In South Africa, this is the Department of Labour.

In 18.1.1.1(c) mention is made to "duty of care principles". In South Africa, the principles are given in volume 1 of the *Minimum requirements for the handling, classification and disposal of hazardous waste*, published by the Department of Water Affairs and Forestry.

In 18.1.2.2 and 18.1.2.4 mention is made of the national department that deals with waste management and disposal. In South Africa it is the Department of Water Affairs and Forestry.

In 19.2.1 and 19.2.2 mention is made of a certificate of compliance issued by the local authority. In South Africa this is regulated by Section 14 of the National Building Regulations of the Building Standards Act, 1977 (Act No. 103 of 1977).

In E.2.2 mention is made of the competent authority on explosives. In South Africa, it is the Chief Inspector of Explosives of the South African Police Service.

SANS 10263 consists of the following parts, under the general title *The warehousing of dangerous goods*:

Part 0: General requirements.

Part 2: The storage and handling of gas cylinders.

Part 5: The storage and handling of oxidizing substances.

A vertical line in the margin shows where the text has been technically modified by amendment No. 1.

Annexes A, B, E, F and G form an integral part of this document. Annexes C and D and the supplement are for information only.

SANS 10263-0:2010

Edition 1.1

This page is intentionally left blank

Contents

	Page
Foreword	
1 Scope	7
2 Normative references	8
3 Definitions	10
4 Application of the standard and classification	13
4.1 Application of the standard	13
4.2 Classification	13
4.3 Dangerous goods listings for packaging	15
5 Preliminary storage considerations	15
5.1 General	15
5.2 Site logistics	16
5.3 Site location	16
5.4 Location and spacing of buildings	17
5.5 Approval by authorities	18
5.6 Warehouse sections and fire sections	18
5.7 Building, site and fire protection plans	19
5.8 Emergency plans and external safety inspection	20
5.9 Pollution control	20
5.10 Facilities to be provided	20
6 Key responsibilities	20
6.1 National, provincial and local authorities	20
6.2 The owner of the goods to be stored	20
6.3 The warehouse controller	21
6.4 Fire authorities	21
6.5 Authority administering this standard	22
7 Types of warehouses	22
7.1 General	22
7.2 Uncovered outdoor storage yard	23
7.3 Covered outdoor storage yard	24
7.4 Surface warehouse	25
7.5 Multi-storey warehouse	26
7.6 High-rack warehouse	27
7.7 Special warehouse	28
8 Warehouse construction	28
8.1 General	28
8.2 Frame	28
8.3 Walls	28
8.4 Floors and spillage containment	30

Contents *(continued)*

	Page
8.5 Roofs	33
8.6 Lightning protection and discharge of electrostatic charges	33
8.7 Doorways and emergency exits	33
8.8 Ventilation, air conditioning and heating	34
8.9 Water supplies and drainage	35
8.10 Lighting	36
8.11 Electrical equipment and installations, other than for lighting	36
8.12 Racks, shelving and warehouse storage technology	37
8.13 Means of impeding the progress of a fire	37
8.14 External signs	37
8.15 Roadways	43
8.16 Rail sidings	44
9 Fire protection measures.....	44
9.1 General	44
9.2 Fire alarm systems	44
9.3 Fire detection systems	45
9.4 Communications with the emergency services	46
9.5 Communications with occupants of the premises	46
9.6 Escape routes	46
9.7 Safety signs, information signs and marking inside the premises	47
9.8 Other technical safety features	47
10 Firefighting	49
10.1 General	49
10.2 Firefighting equipment and media	49
10.3 Fire routine	54
10.4 Firefighting technique	55
10.5 Fires involving toxicants	56
11 Warehouse organization and warehouse technology	56
11.1 Separation of functional areas	56
11.2 Warehouse storage technology	60
11.3 Use of pallets	65
11.4 Use of fork-lift trucks	66
11.5 Product-specific technology	68
12 Safe operating practice and good housekeeping	69
12.1 General	69
12.2 Equipment and compliance	69
12.3 Personal protective clothing and equipment.....	69
12.4 Washing facilities	72
12.5 Safety Data Sheets (SDS)	73
12.6 Product information file	73
12.7 Stock list	74
12.8 Separation and segregation	74
12.9 Storage plan	79
12.10 Stock rotation	79

Contents *(continued)*

	Page
12.11 Checking of labelling	79
12.12 Inspection for damage and leakage	80
12.13 Dealing with leakage or spillage	80
12.14 Good housekeeping	83
12.15 Safety and first-aid facilities	84
12.16 Maintenance of control measures	85
13 Health, safety and environmental policy, operating procedures and house rules	85
13.1 Health, safety and environmental policy	85
13.2 Operating procedures	85
13.3 Site rules	87
14 Personnel and administrative issues	87
14.1 Selection of employees	87
14.2 Work-exposure record	87
14.3 Minimum requirements for health surveillance	87
14.4 Organizational structure	88
14.5 Job knowledge	88
14.6 Training	88
14.7 Emergency drills	89
14.8 Supervision	90
14.9 Workplace hygiene	90
15 Security	90
15.1 Access control	90
15.2 Twenty-four-hour manning	91
16 Emergency planning	91
17 Receipt and despatch	91
18 Waste disposal and post-fire clean-up	93
18.1 Waste disposal	93
18.2 Post-fire clean-up	94
19 Routine safety checks	96
19.1 General	96
19.2 External safety inspections	97

Contents (concluded)

	Page
Annex A (normative) Quantities of the various classes and divisions of dangerous goods for which the provisions of this standard apply	98
Annex B (normative) Permitted storage quantities per fire section, and the firefighting water supply requirements	99
Annex C (informative) Water retention volumes in spillage containment areas	101
Annex D (informative) Example of a routine safety checking schedule	102
Annex E (normative) Dangerous goods compatibility chart for storage and special provisions	107
Annex F (normative) First aid	110
Annex G (normative) Information to be included in an emergency plan.....	115
Annex H (informative) Competent authority designation.....	118
Bibliography	119

The warehousing of dangerous goods

Part 0: General requirements

1 Scope

This document lays down design features and procedures to be followed to minimize risks to the safety of persons, property and the environment in cases where emergencies occur in warehouses used for the storage of dangerous goods. It applies to the warehousing of dangerous goods in excess of certain quantities.

This document applies to the uncovered and covered storage of dangerous goods in warehouses that form part of a manufacturing operation, in distributors' warehouses, and in the storage areas of wholesale and retail premises.

Some of the provisions of this standard might not apply in certain cases, for example small-scale business enterprises. Notwithstanding the provisions of annex A, this standard does not apply to areas where limited materials are displayed and advertised on shelves for sale to the public (as in the retail sections of supermarkets, hardware shops, home garden outlets, etc.), or to storage areas in laboratories.

The requirements of this standard do not apply to the storage of pesticides (see SANS 10206).

NOTE 1 Annex A lists, by SANS 10228 classification, the quantities of dangerous goods to which the provisions of this standard apply.

NOTE 2 The provisions of this standard are likely to vary in their applicability to the warehousing of different types or classes of dangerous goods. Ultimately, the elements of safe warehousing practice are determined by the nature of the goods stored. In some cases, actions, precautions and provisions that are additional to or different from those outlined in this standard could be required. Although it is believed that the adoption of this standard will help to reduce the risk of accident, the SABS Standards Division cannot accept any responsibility for any kind of damage or alleged damage in or about the premises, areas or vehicles to which this standard has been applied.

NOTE 3 Where the provisions of this standard conflict with, or appear to diverge from, the regulations (as defined in 3.12), the regulations take precedence. This standard is intended to supplement the regulations by giving greater detail in certain areas than can be provided for in the regulations, which, because of necessity, are drafted in broad terms.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Information on currently valid national and international standards can be obtained from the SABS Standards Division.

ANSI/NFPA 11, *Standard for low-, medium- and high-expansion foam systems*.

SANS 509/ISO 509, *Pallet trucks – Principal dimensions*.

SANS 543, *Fire hose reels (with semi-rigid hose)*.

SANS 1128-1, *Firefighting equipment – Part 1: Components of underground and above-ground hydrant systems*.

SANS 1128-2, *Firefighting equipment – Part 2: Hose couplings, connectors, and branch pipe and nozzle connections*.

SANS 1186-1, *Symbolic safety signs – Part 1: Standard signs and general requirements*.

SANS 1253, *Fire-doors and fire-shutters*.

SANS 1456-1, *Collapsible delivery hose for fire-fighting purposes – Part 1: General requirements and methods of test*.

SANS 1522, *Fire extinguishing powders*.

SANS 1567, *Portable rechargeable fire extinguishers – CO₂ type extinguishers*.

SANS 1726-1/EN 1726-1, *Safety of industrial trucks – Self-propelled trucks up to and including 10 000 kg capacity and industrial tractors with a drawbar pull up to and including 20 000 N – Part 1: General requirements*.

SANS 1726-2/EN 1726-2, *Safety of industrial trucks – Self-propelled trucks up to and including 10 000 kg capacity and tractors with a drawbar pull up to and including 20 000 N – Part 2: Additional requirements for trucks with elevating operator position and trucks specifically designed to travel with elevated loads*.

SANS 1910, *Portable refillable fire extinguishers*.

SANS 10086-3 (SABS 086-3), *The installation, inspection and maintenance of equipment used in explosive atmospheres – Part 3: Repair and overhaul of apparatus used in explosive atmospheres*.

SANS 10100-1 (SABS 0100-1), *The structural use of concrete – Part 1: Design*.

SANS 10100-2 (SABS 0100-2), *The structural use of concrete – Part 2: Materials and execution of work*.

SANS 10104 (SABS 0104), *Handrailing and balustrading (safety aspects)*.

SANS 10105-1, *The use and control of fire-fighting equipment – Part 1: Portable and wheeled (mobile) fire extinguishers*.

SANS 10105-2, *The use and control of fire-fighting equipment – Part 2: Fire hose reels, hydrants and booster connections*.

SANS 10108, *The classification of hazardous locations and the selection of apparatus for use in such locations.*

SANS 10114-1, *Interior lighting – Part 1: Artificial lighting of interiors.*

SANS 10119 (SABS 0119), *Reduction of explosion hazards presented by electrical equipment – Segregation, ventilation and pressurization.*

SANS 10123 (SABS 0123), *The control of undesirable static electricity.*

SANS 10137 (SABS 0137), *The installation of glazing in buildings.*

SANS 10139, *Fire detection and alarm systems for buildings – System design, installation and servicing.*

SANS 10142-1, *The wiring of premises – Part 1: Low voltage installations.*

SANS 10143 (SABS 0143), *Building drawing practice.*

SANS 10160 (SABS 0160), *The general procedures and loadings to be adopted in the design of buildings.*

SANS 10161 (SABS 0161), *The design of foundations for buildings.*

SANS 10162-1, *The structural use of steel – Part 1: Limit-states design of hot-rolled steelwork.*

SANS 10162-2 (SABS 0162-2), *The structural use of steel – Part 2: Limit-states design of cold-formed steelwork.*

SANS 10163-1, *The structural use of timber – Part 1: Limit-states design.*

SANS 10163-2 (SABS 0163-2), *The structural use of timber – Part 2: Allowable stress design.*

SANS 10164-1 (SABS 0164-1), *The structural use of masonry – Part 1: Unreinforced masonry walling.*

SANS 10164-2, *The structural use of masonry – Part 2: Structural design and requirements for reinforced and prestressed masonry.*

[SANS 10206, *The handling, storage and disposal of pesticides.*](#)

SANS 10220, *The selection, use and maintenance of respiratory protective equipment.*

[SANS 10228:2006, *The identification and classification of dangerous goods for transport.*](#)

[SANS 10229-1, *Transport of dangerous goods – Packaging and large packaging for road and rail transport – Part 1: Packaging.*](#)

[SANS 10229-2, *Transport of dangerous goods – Packaging and large packaging for road and rail transport – Part 2: Large packaging.*](#)

[SANS 10231, *Transport of dangerous goods – Operational requirements for road vehicles.*](#)

[SANS 10232-1, *Transport of dangerous goods – Emergency information systems – Part 1: Emergency information system for road transportation.*](#)

SANS 10263-0:2010

Edition 1.1

SANS 10233, Transport of dangerous goods – Intermediate bulk containers for road and rail transport.

SANS 10234, Globally Harmonized System of classification and labelling of chemicals (GHS).

SANS 10263-2, The warehousing of dangerous goods – Part 2: The storage and handling of gas cylinders

SANS 10263-5, The warehousing of dangerous goods – Part 5: The storage and handling of oxidizing substances.

SANS 10313, Protection against lightning – Physical damage to structures and life hazard.

SANS 10400 (SABS 0400:1990), The application of the National Building Regulations.

SANS 10406, Transport of dangerous goods – The reprocessing of previously certified packaging.

SANS 11014/ISO 11014, Safety data sheet for chemical products – Content and order of sections.

3 Definitions

For the purposes of this document, the following terms and definitions apply.

3.1

approved

approved by the authority administering this standard

3.2

competent person

person who is qualified by virtue of his experience and training

3.3

dangerous (hazardous) goods

dangerous substances or goods, as identified and classified in SANS 10228, that are stored before being offered for transport by a manufacturer, distributor, wholesaler or retailer, or that are stored by an end user

NOTE For the purposes of this standard, the terms

a) “dangerous” and “hazardous” are synonymous, and

b) “goods” and “product” are used interchangeably and, except where it is clear from the context that the normal dictionary meaning of a term is intended, they refer to dangerous goods, as defined in 3.3.

3.4

documented

provided in writing

3.5

empty packaging

previously certified packaging from which contents have been removed as far as possible, by means of the practices commonly employed to remove materials from that type of container, for example pouring, pumping, or aspirating

3.6

enclosed warehouse

surface warehouse (see 7.4), a multi-storey warehouse (see 7.5), a high-rack warehouse (see 7.6) or a special warehouse (see 7.7)

3.7

fire section

warehouse section in which products of one or more SANS 10228 classes are to be stored, that has been designed for the storage of specific products, and that is intended to confine or retard the progress of a fire

NOTE Maximum permissible storage quantities and minimum permissible fire-fighting water supplies are laid down for each fire section (see annex B).

3.8

non-combustible

classified as non-combustible when tested in accordance with SANS 10177-5

3.9

occupancy class

occupancy or building classification, as defined in table 1 of part A of the National Building Regulations

3.10

package

complete product of the packing operation, consisting of the packaging and its contents

3.11

packaging

receptacles and any other components or material necessary for a receptacle to perform its containment function

3.12

regulations

any relevant current national, provincial or local authority legislation or by-laws, or regulations promulgated in terms of any Act of Parliament

3.13

safety data sheet

document, issued by a manufacturer of dangerous goods, that lists information about the handling, storage, transport and emergency procedures relevant to the dangerous goods supplied by the manufacturer

3.14

segregation

positioning of products of different classes or divisions in terms of SANS 10228 in separate areas within a warehouse

NOTE The concepts "segregation" and "separation" are subject to widespread misinterpretation in industry; considerable differences in usage exist, and there is no universally accepted set of definitions for these terms. The onus is nevertheless on the warehouse controller to ensure at all times that products are stored in a safe and responsible manner (see table B.1).

3.15

separating element

wall or floor that has a specific fire resistance and that is used between divisions, occupancies or tenancies in a building

NOTE See SANS 10400 for further information.

3.16

separation

physical separation of different product groups, either in separate warehouses or by means of separating elements, such as a wall, that has a specific fire resistance and that is used between divisions within a warehouse

NOTE 1 See the note to 3.14.

NOTE 2 See SANS 10400 for further information on fire-resistant separating elements.

3.17

United Nations (UN) number

serial number that consists of four digits and that is assigned to dangerous goods by the United Nations' Committee of Experts on the Transport of Dangerous Goods

3.18

warehouse controller

responsible person(s) on site, including, where applicable, the responsible person(s) appointed in terms of the regulations (see 3.12), and the competent person(s) appointed to take charge of specific operations in a warehouse.

3.19

warehouses

3.19.1

dangerous-goods warehouse

any area, building or structure designed, intended or used for, or to facilitate, the storage of dangerous goods in excess of the applicable quantities detailed in annex A

3.19.2

stock warehouse

building(s) or part(s) of a building in which dangerous goods are actually stored

3.20

warehouse section

subdivision of a warehouse, the dimensions, features and location of which have been determined by a process of reasoning or calculation (or both) that have regard to the nature of the products to be stored in it

3.21

warehousing

receipt, marshalling, storage and despatch of dangerous goods

4 Application of the standard and classification

4.1 Application of the standard

There is no objection to the use of other national or international standards, or systems, methods, or devices that comply with or exceed the requirements of this standard, provided technical documentation is submitted to the authority that has jurisdiction that demonstrates compliance with this standard through rational design and provided that the system, method, or device is approved for the intended purpose.

4.2 Classification

4.2.1 General

For the purposes of this standard, dangerous substances are classified into classes and divisions depending on the hazards they pose and into categories depending on the severity of the hazard. Testing shall be performed in accordance with SANS 10228.

NOTE All aspects of the identification and classification of dangerous goods for transport are dealt with in detail in SANS 10228.

4.2.2 Class 1: explosives

4.2.2.1 Substances, mixtures and articles of this class that are not classified as an unstable explosive (see SANS 10234) are assigned to one of six divisions depending on the type of hazard they represent:

a) **division 1.1** – substances, mixtures and articles that present a mass explosion hazard;

NOTE A mass explosion is one that affects the entire quantity present, virtually instantaneously.

b) **division 1.2** – substances, mixtures and articles that present a projection hazard but not a mass explosion hazard;

c) **division 1.3** – substances, mixtures and articles that present a fire hazard and either a minor blast hazard or a minor projection hazard or both, but not a mass explosion hazard:

1) combustion of which gives rise to considerable radiant heat; or

2) which burn one after another, producing minor blast or projection effects (or both);

d) **division 1.4** – substances, mixtures and articles that present:

1) no significant hazard; and

2) only a small hazard in the event of ignition or initiation. The effects are largely confined to the package and no projection of fragments of appreciable size or range is to be expected. An external fire shall not cause virtually instantaneous explosion of almost the entire contents of the package;

e) **division 1.5** – very insensitive substances or mixtures that present a mass explosion hazard, but are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions; and

f) **division 1.6** – extremely insensitive articles that do not present a mass explosion hazard and the probability of accidental initiation or propagation is negligible.

NOTE The risk of explosion is limited to a single article.

4.2.2.2 Explosives, other than unstable explosives, are classified in one of the six divisions in accordance with Test Series 2 to Test Series 8 in Part I of the United Nations' *Recommendations on the transport of dangerous goods: Manual of tests and criteria* (see also SANS 10228).

4.2.3 Class 2: gases

This class is subdivided as follows:

- a) **division 2.1:** flammable gases;
- b) **division 2.2:** non-flammable, non-toxic gases; and
- c) **division 2.3:** toxic gases.

4.2.4 Class 3: flammable liquids

A flammable liquid is classified in one of the four categories as indicated in table 1.

Table 1 — Categories and classification criteria for flammable liquids

1	2
Category	Classification criteria
1	Closed-cup flash point < 23 °C and initial boiling point ≤ 35 °C
2	Closed-cup flash point < 23 °C and initial boiling point > 35 °C
3	Closed-cup flash point ≥ 23 °C ≤ 60 °C
4	Flash point > 60 °C and ≤ 93 °C

4.2.5 Class 4: flammable solids; substances liable to spontaneous combustion; substances that, on contact with water, emit flammable gases – Types of self-reactive substances or mixtures

This class is subdivided as follows:

- a) **division 4.1:** flammable solids, self-reactive substances and solid desensitized explosives;
- b) **division 4.2:** substances liable to spontaneous combustion (pyrophoric and self-heating substances category 1 and 2); and
- c) **division 4.3:** substances that, on contact with water, emit flammable gases.

4.2.6 Class 5: oxidizing substances and organic peroxides

This class is subdivided as follows:

- a) **division 5.1:** oxidizing substances; and
- b) **division 5.2:** organic peroxides.

4.2.7 Class 6: toxic and infectious substances

This class is subdivided as follows:

- a) **division 6.1:** toxic substances; and
- b) **division 6.2:** infectious substances.

4.2.8 Class 7: radioactive material

This class has no subclasses.

4.2.9 Class 8: corrosives

This class has no subclasses and comprises substances that, by chemical action, cause damage to living tissue, to commonly used metals, or to packaging.

4.2.10 Class 9: miscellaneous dangerous substances

This class has no subclasses and comprises any substance not covered by other classes, but that has been, or could be shown by experience, to be of such a dangerous character that the provisions of this class should apply to it.

4.3 Dangerous goods listings for packaging

4.3.1 General

South Africa has adopted the globally used UN classification, numbering and packaging systems for dangerous goods. These are published in SANS 10228 for classification, SANS 10229-1 and SANS 10229-2 for packaging, and SANS 10233 for intermediate bulk containers.

4.3.2 Annex B of SANS 10228:2006

4.3.2.1 B.1 of SANS 10228:2006 gives the relevant special provisions relating to individual articles or substances.

4.3.2.2 B.2 of SANS 10228:2006 consists of a numerical list of dangerous goods and gives, in tabulated form, the information required for identification and classification, i.e. the UN number, the technical name and description, the class, the packing group, the subsidiary risk, references to appropriate packing instructions, and special provisions and limited quantity requirements.

4.3.3 Annex C of SANS 10228:2006

This annex consists of an alphabetical list of dangerous goods and gives, in tabulated form, the proper shipping name, the UN number and the class or division.

5 Preliminary storage considerations

5.1 General

5.1.1 In general, before a warehouse may store dangerous substances of any class (see 4.2) or of any hazard category, all the relevant provisions of this standard, and all relevant regulations (as defined in 3.12) shall be complied with. The storage of certain dangerous goods is subject to product-specific regulations.

5.1.2 If certain classes of dangerous substances, for example explosives and radioactive material, are not going to be stored, the legislation and regulations relevant to those classes are unlikely to be applicable (see foreword).

5.1.3 If a warehouse is to restrict itself to the storage of flammable substances of category 3 only, or of category 2 and category 3, certain provisions of this standard may be relaxed by the authority administering this standard.

5.1.4 If a warehouse does not comply with all the relevant provisions of this standard necessary for it to be permitted to store flammable substances of category 3, it is unlikely that it will be permitted to store flammable substances of category 2.

5.1.5 Similarly, if a warehouse does not comply with all the relevant provisions of this standard necessary for it to be permitted to store flammable substances of category 2, it is unlikely that it will be permitted to store flammable substances of category 1.

5.1.6 The specific provisions of this standard that have to be complied with in any particular case will be determined by the authority administering this standard. For example, certain provisions of this standard may be relaxed, or might not apply, where small-scale warehousing operations are concerned.

5.1.7 The class(es) and hazardous categories of substances to be stored, and the size of the proposed warehousing operation, will determine the necessary degree of compliance with this standard, the regulations that have to be complied with, and, ultimately, the scale and cost of the warehousing operation.

5.2 Site logistics

A company or an organization that requires the use of more than one warehouse shall, as far as is practicable, minimize the overall hazard by selecting an appropriate compromise between:

- a) the minimum number of warehouse sites necessary to satisfy customer requirements; and
- b) the hazards incurred in road and rail transport of dangerous goods between sites.

5.3 Site location

A company or an organization, when proposing a location for a warehouse and when applying for authority to set up or extend a warehouse, and the local, provincial or national authorities responsible for considering such an application, shall undertake an environmental impact assessment, and in so doing, shall take the following into account:

- a) the nature of the goods that will be stored, proposed stock levels (taking into account seasonal variations) and the degree of hazard that will be presented;
- b) the zoning or land-use requirements of the local authority;
- c) proximity to houses, schools, hospitals, offices, factories and similar high-occupancy areas and to potential external sources of hazard, and the level of the ground in relation to such areas;
- d) fire protection, security, and general service facilities in the area;
- e) population densities around the proposed warehouse;
- f) proximity to water courses (surface and underground) and to open storm water channels;

- g) proximity to combustible vegetation;
- h) prevailing winds and other climatic factors;
- i) the stability of the ground on which buildings and roadways will be constructed;
- j) the highest recorded flood level in the proposed storage area, and the susceptibility of the area to flooding;
- k) access to the site by road and rail;
- l) access to the site, and in particular to buildings, by emergency service vehicles, and the desirability of allowing the parking of vehicles in areas adjoining the buildings;
- m) safe escape from the effects of fire or other hazards in each of the proposed buildings on site;
- n) the adequacy of the services to be provided, including
 - 1) electricity supply and emergency supply, if needed,
 - 2) potable and firefighting water supply, and
 - 3) drainage that
 - **either** prevents ground run-off to public sewers and storm drains,
 - **or** allows run-off to a waste treatment plant intended to be used for on-site containment of run-off water and spills,
 - **or** does both;
- o) future expansion;
- p) the depth of the water table (if above the first impermeable layer) and the date of measurement;
- q) the soil types above the first impermeable layer; and
- r) the location of any existing boreholes or artesian wells within 500 m of the site, and an analysis of their water for pollutants (especially hydrocarbons) likely to be generated in the event of a major fire or spillage in the proposed premises.

NOTE To facilitate future monitoring of the environment, (p) (q) and (r) above, in particular, should be recorded before construction commences.

CAUTION — Consideration should be given to the locations of existing warehouses and a Risk Assessment carried out in terms of this standard.

5.4 Location and spacing of buildings

5.4.1 Separate administrative buildings

Administrative buildings shall, if the scale of operations permits, be separate from buildings in which dangerous goods are stored. Separate administrative buildings shall be located in a safe area (preferably near the main gates), with direct access from the roadway so that visitors to the offices only are not required to enter the operational area of the warehouse. As far as is practicable, no offices, eating areas or change rooms shall be built as an integral part of a stock warehouse.

5.4.2 Stock warehouses

If the outer boundary of the site is constructed of open-type fencing, a stock warehouse that contains flammable materials shall be sited at least 22 m away from the boundary. The authority administering this standard might allow this distance to be reduced if the boundary consists of a solid wall, or if the quantities and types of flammable material stored are such that this distance is deemed unnecessary.

5.4.3 Service buildings

Service buildings do not constitute an inherent fire hazard, but could include open fires or other fire hazards. They shall be sited in areas away from places where dangerous goods are stored and handled, and out of the line of possible vapour travel.

5.4.4 Boiler houses, power plants, fire pump slabs and similar installations

Boiler houses, power plants, fire pump slabs and similar installations, shall be so located that their equipment can be operated safely in the event of a fire occurring elsewhere on the site.

5.4.5 Buildings on boundaries

The walls of any buildings, other than buildings in which dangerous goods are stored, may, subject to the regulations, form part of the boundary of the site.

5.5 Approval by authorities

5.5.1 No warehousing operation shall be started in any premises unless application has been made to the authority(ies), the necessary permission has been obtained from all relevant department(s) (fire, public health, sewerage, building inspectorate, etc.), and a certificate of occupancy has been issued by the authority in terms of the National Building Regulations (see foreword). All permits shall be renewed as necessary and as required by the authorities. The carrying out or continuation of a warehousing operation without the prescribed permits is not permitted.

5.5.2 When a proposed change of occupancy brings premises within the scope of this standard, the relevant provisions of 5.5.1 shall be complied with before warehousing operations may start. In particular, an existing building or part of a building in which a change of occupancy to warehousing as defined in 3.21 is proposed, shall be required to comply fully with National Building Regulations (see foreword).

5.5.3 Early consultation with the relevant authorities is recommended, as is the provision of an adequate brief covering the intended use of the premises and the goods intended to be stored or used. In this way, the necessary permits, such as flammable liquids permits, can be applied for in good time and the need to provide costly additional measures, such as fire safety measures, after the premises are otherwise ready for occupation, could be avoided.

5.6 Warehouse sections and fire sections

5.6.1 The minimum number of warehouse sections needed shall be estimated from a knowledge of the dangerous goods to be stored (see SANS 10228), their separation and segregation requirements (see 12.8), and any product-specific requirements, such as climatic control.

5.6.2 The minimum number of fire sections needed shall be estimated from a knowledge of the dangerous goods and the quantities to be stored (see table B.1).

5.6.3 Estimates shall then be made of the optimum numbers, sizes and constructional requirements of individual warehouse sections and fire sections, taking into account variables such as

- a) firefighting water requirements (see annex B),
- b) spillage containment requirements (see 8.4),
- c) technical safety requirements, for example, explosion prevention measures, and
- d) anticipated fire detection and firefighting capability.

5.6.4 These estimates shall be taken into account in the drawing up of building and site plans. In particular, the possible benefits of separating all flammable materials from other goods shall be considered. The feasibility of such an arrangement will depend on the relative quantities to be stored.

5.7 Building, site and fire protection plans

5.7.1 The building and site plans shall comply with national building regulations (see A.2 and A.3 of SANS 10400:1990).

5.7.2 A fire protection plan as described in A.9 of SANS 10400:1990 shall be completed in respect of

- a) all new warehouse buildings,
- b) extensions to existing warehouse buildings, and
- c) any building in which a change of use is proposed which would bring the use of the building within the scope of this standard.

5.7.3 The storage areas in a stock warehouse are classified in classes of occupancy as follows:

- a) **High-risk storage (J1):** Occupancy where the stored goods are liable, in the event of fire, to cause combustion with extreme rapidity or give rise to poisonous fumes, or cause explosions.
- b) **Moderate-risk storage (J2):** Occupancy where the stored goods are liable, in the event of fire, to cause combustion with moderate rapidity but not likely to give rise to poisonous fumes, or cause explosions.
- c) **Low-risk storage (J3):** Occupancy where the goods stored do not fall into the high or moderate risk category.

NOTE Any space used for the storage of flammable liquids is not deemed to be a J1 occupancy if the quantity of liquid

- a) does not exceed 40 L, or
- b) exceeds 40 L but does not exceed 200 L and the closed-cup flash point of such a liquid is above 40 °C.

5.8 Emergency plans and external safety inspection

Before warehousing operations start, the necessary emergency plans shall have been completed and distributed (see clause 16), the initial external safety inspection (see 19.2.1) shall have been carried out and a certificate of compliance with the provisions of this standard shall have been obtained.

5.9 Pollution control

The design and operation of the warehouse shall be such that the storage of dangerous goods will not cause contravention of the relevant national regulations and statutory provisions, in that all reasonable steps shall be taken to prevent pollution (see foreword).

NOTE See part P of the National Building Regulations.

5.10 Facilities to be provided

The combination of facilities to be provided in a warehouse, including the design of buildings, all safety-related and fire-related facilities and the type(s) of warehouse technology and operating equipment required, shall be determined by a logical process that takes into account all relevant circumstances, risks and uses to which the warehouse will be subjected.

6 Key responsibilities

6.1 National, provincial and local authorities

6.1.1 Before issuing permits to start or continue warehousing operations, authorities shall ensure that the relevant provisions of clause 5 and the regulations have been met (see 6.4 for the specific responsibilities of the fire authorities).

6.1.2 Authorities shall not permit incompatible buildings or facilities (such as schools and shops) to be built too close to a proposed or existing warehouse site.

6.2 The owner of the goods to be stored

6.2.1 The owner of the goods to be stored in a warehouse shall, as far as is practicable, satisfy himself that the warehouse controller will ensure compliance with the provisions of this standard, and, in particular, that

- a) the warehouse is suitable for its intended purpose,
- b) the warehouse controller is trained and competent to carry out the required storage,
- c) the warehouse controller clearly understands what is expected,
- d) information is supplied to the warehouse controller to ensure and enable safe storage, for example:

- 1) details of the hazards of the goods;
 - 2) Safety Data Sheets (see 12.5);
 - 3) recommendations for safe handling;
 - 4) instructions to be followed in the event of a spill or leak;
 - 5) first-aid instructions; and
 - 6) a 24-h emergency telephone number through which specialist advice can be obtained,
- e) the warehouse controller formally acknowledges in writing receipt of such information and confirms that it has been understood, and
- f) the safety, fire protection and emergency arrangements instituted by the warehouse controller are adequate.

6.2.2 The various responsibilities shall be documented, preferably in contract form, and shall allow for regular inspections of the warehouse by the owner of the goods. Where the owner of the goods is also the owner of the warehouse, such a contract is clearly inappropriate; the owner shall nevertheless comply with the other provisions of this subclause as if a third-party relationship existed.

6.3 The warehouse controller

6.3.1 The responsibilities of the warehouse controller shall be stipulated in writing.

6.3.2 The warehouse controller shall be responsible for the occupational health and safety of the people in the warehouse, the safe receipt, marshalling, storage and despatch of goods and the protection of the environment from the hazardous effects of goods stored in the warehouse. Specific responsibilities may be delegated to nominated personnel (see also 6.3.5).

6.3.3 The warehouse controller shall be aware of, and shall comply with, all relevant regulations concerning the employment of personnel.

6.3.4 The warehouse controller shall be aware of, and shall comply with, all relevant regulations concerning the handling and storage of goods to be stored.

6.3.5 The warehouse controller shall entrust the execution of the relevant provisions of this standard to appropriately qualified and experienced people, and shall provide ongoing training as necessary, to ensure the maintenance of standards (see 14.6).

6.3.6 The warehouse controller shall be responsible for communications with the relevant authorities to ensure continuing validity of permits as well as reporting and investigating of any incidents or accidents that occur which may impact on the environment.

6.4 Fire authorities

6.4.1 Fire authorities shall be aware of all warehouses that operate within their area of control, and shall ensure that ongoing liaison is maintained with warehouse controllers and, as necessary, with other emergency services.

6.4.2 Fire authorities shall co-operate with warehouse controllers to ensure that emergency plans (see clause 16) are produced and regularly reviewed, and that any routine checks, assistance with training, or similar activities for which fire authorities have assumed responsibility, are carried out.

6.4.3 Each fire authority shall maintain in an orderly manner, all information, emergency plans and contact telephone numbers with respect to warehouses that operate within its area of control.

6.4.4 Fire authorities shall have access to the necessary personnel and equipment, and shall install the necessary systems, including training programmes, to ensure a rapid, effective response to a fire or other emergency in a warehouse that operates within their area of control.

6.5 Authority administering this standard

The authority administering this standard shall assess the degree to which a warehouse complies with the relevant provisions of this standard and shall consider the granting of exemptions where appropriate. The authority shall, depending on the assessed degree of compliance, authorize the warehouse controller to conduct operations in relation to the storage of dangerous goods of specific SANS 10228 classes, and of specific packing groups. Re-assessments shall be carried out on a regular basis to ensure continued compliance, and appropriate certificates of compliance with the provisions of this standard shall be issued or renewed as necessary.

7 Types of warehouses

7.1 General

7.1.1 The following shall be considered when the type of warehouse needed is being selected:

- a) the technical safety aspect;
- b) the logistical suitability of the design; and
- c) capital investment and operating costs.

7.1.2 A warehouse shall be of one of the following types, which are covered in greater detail in 7.2 to 7.7 (inclusive):

- a) uncovered outdoor storage yard;
- b) covered outdoor storage yard;
- c) surface warehouse;
- d) multi-storey warehouse;
- e) high-rack warehouse; and
- f) special warehouse.

7.1.3 The warehouse storage technologies used shall be appropriate for the storage situation(s) encountered. Technologies available for use in warehouses are described in detail in 11.2.

7.2 Uncovered outdoor storage yard

7.2.1 General

An uncovered outdoor storage yard consists of an outdoor area that is surfaced with impervious material. An uncovered outdoor storage yard shall only be operated within the confines of a secured site or plant area, with proper provision for containment (see 7.2.3).

7.2.2 Products that may be stored

An uncovered outdoor storage yard is generally suitable for all goods that are insensitive to temperature and that have weatherproof packaging and marking.

CAUTION — Storage of explosives, radioactive material, water-reactive substances, and infectious substances (SANS 10228 classes 1 and 7, and divisions 4.3 and 6.2, respectively) in uncovered outdoor storage yards is expressly prohibited.

7.2.3 Drainage and discharge

The storage area shall not be connected to a sewer direct; it shall be constructed in the form of a retaining basin (and, if appropriate, in combination with a separate catch basin) equipped with a drain valve, from which no water, even rainwater, should be pumped unless analysis of the proposed discharge has shown it to be safe and within permitted limits. The drain valve shall be kept closed during normal operations. The storage area shall be surrounded by, but not connected to, appropriate storm drains to prevent the ingress of large quantities of water during severe rainstorms (see also 8.4.4).

7.2.4 Advantages and disadvantages

7.2.4.1 Advantages

An uncovered outdoor storage yard offers advantages over enclosed constructions for the storage of gases and flammable liquids (SANS 10228 classes 2 and 3 respectively), because the natural ventilation prevents a hazardous, explosive atmosphere from arising in all but the most extreme of cases.

7.2.4.2 Disadvantages

The following potential disadvantages exist:

- a) heating of goods by solar radiation, coupled with possible damage to, or decomposition of, goods;
- b) damage to goods owing to frost;
- c) damage (for example, corrosion damage) to packaging owing to precipitation;
- d) damage to marking owing to weathering (ultraviolet radiation, rain, etc.);
- e) damage to the surface appearance of the packaging after lengthy outside storage, reducing the saleability of goods and causing additional disposal needs;

NOTE Useful measures against these weathering effects include the use of sprinkling systems, tarpaulins to cover goods and the implementation of intensive checking.

- f) lower security against theft than in locked buildings.

7.2.5 Firefighting implications

7.2.5.1 An uncovered outdoor storage yard offers the best firefighting conditions for flammable products (no smouldering, immediate detection of the source of a fire and good accessibility).

7.2.5.2 In large, uncovered outdoor storage yards, the required fire sections shall be formed by allowing gaps of width at least 10 m, or by the interposition of separating elements that are at least 1 m higher than the highest storage stack.

7.2.6 Warehouse technology

7.2.6.1 An uncovered outdoor storage yard is suitable for small ranges of high-turnover goods in large quantities. It is preferable that only complete storage units (such as pallets and containers) be stored.

7.2.6.2 Block storage is the most appropriate warehouse technology for uncovered outdoor storage yards (see 11.2.2 to 11.2.4). The allowable useful height is likely to be about 4 m when pallets are stored, and up to 6 m when small containers are stored.

7.2.7 Costs

If the price of the land is low, the capital costs per storage unit for an uncovered outdoor storage yard are the lowest of all types of warehouse. The operating costs are also attractive in comparison with those of other types of warehouses. However, the additional costs of necessary special measures, such as sprinkling systems and rainwater disposal, need to be taken into account.

7.3 Covered outdoor storage yard

7.3.1 General

A covered outdoor storage yard consists of an outdoor area that is surfaced with impervious material and that has a light-duty roofing construction; it has no enclosing outer walls. Projecting roofing sections, canopies or venetian blinds can be used to protect the storage area against lateral driving rain or lateral solar radiation. A covered outdoor storage yard shall only be operated within the confines of a secured site or plant area.

7.3.2 Products that may be stored

A covered outdoor storage yard is suitable for all products that are insensitive to temperature but that need to be protected against the direct effects of weathering because of their properties or their packaging and marking. Provided that the storage area surface has a basin shape and is surrounded by sufficient storm drains, a covered outdoor storage yard may be used for storing temperature-insensitive, water-polluting products, since it is unnecessary to consider either the quantity of or the disposal of rainwater.

7.3.3 Drainage and discharge

The provisions of 7.2.3 shall apply; in addition, roof run-off shall be drained to storm drains outside the storage area (see also 8.4.4).

7.3.4 Advantages and disadvantages

Because of the good ventilation, a covered outdoor storage yard has the same advantage as an uncovered yard, in that a hazardous, explosive atmosphere can rarely be formed. The climatic disadvantages of a covered outdoor yard are less pronounced, although product damage owing to frost remains a possibility.

7.3.5 Firefighting implications

A covered outdoor storage yard permits the installation of both fire-detection systems and semi-stationary or automatic fire-extinguishing facilities.

7.3.6 Warehouse technology

The presence of a roof permits the installation of all warehouse technologies; various product ranges and movement structures can therefore be accommodated.

7.3.7 Costs

The capital and operating costs for a covered outdoor storage yard are only slightly higher than for an uncovered outdoor storage yard.

7.4 Surface warehouse

7.4.1 General

A surface warehouse is a building of only one storey, enclosed on all sides, and is the most common type of warehouse. The floor of the warehouse marshalling area (see 7.4.4.2) is either at the level of the traffic area (ground-floor warehouse) or approximately 1 200 mm above it (ramp warehouse).

7.4.2 Products that may be stored

Depending on the construction and building facilities, products of all SANS 10228 classes can be catered for.

7.4.3 Firefighting implications

All types of firefighting equipment and apparatus can be accommodated.

7.4.4 Warehouse technology

7.4.4.1 General

All warehouse technologies are applicable. The enclosed construction allows for economical material flow and good accessibility both in normal operation and in an emergency. The useful height of a surface warehouse varies between 4 m for normal block storage and 14 m for rack storage that uses high-lift fork trucks or automatic rack servers on guide rails.

7.4.4.2 Floor levels

The type(s) of vehicle used to transport goods into and from the warehouse and the product movement structure determine the preferred floor level of the warehouse:

- a) a ramp warehouse is the most economical alternative when the warehouse caters for a high proportion of rail vehicles, large containers on flat-bed carriers and rear-loading hard-top road vehicles;
- b) a ground-floor warehouse is preferable when most of the traffic consists of road vehicles that are unloaded and loaded from the side, or when large containers are the main traffic elements and can then be deposited in the traffic area;

- c) a ground-floor warehouse is particularly suitable for large-volume packaged goods with predominantly uniform storage and shipping units, provided that fast, relatively heavy-duty fork-lift trucks can load and unload the vehicles from the side;
- d) where a significant amount of traffic movement involves packaged goods with a relatively high proportion of heterogeneous or small-volume loading units, loading and unloading of vehicles from the rear is more easily carried out from ramp level.

NOTE Mixed-floor designs allow for greater flexibility than single-floor designs. For example, ramp spaces can be created in ground-floor warehouses by a reduction in the level of a portion of the traffic area, and ground-level loading areas can be created in ramp warehouses by the use of ramps of different gradients. See also 8.4.3, which covers spillage containment.

7.4.5 Costs

Capital costs for the building itself, for the warehouse and for safety equipment required, depend on the care taken in selecting appropriate warehouse technologies to ensure the economical utilization of warehouse space.

7.5 Multi-storey warehouse

7.5.1 General

A multi-storey warehouse is a building with two or more storeys, and is generally enclosed on all sides.

7.5.2 Products that may be stored

For economical and safety reasons, a multi-storey warehouse shall not be used for storage of higher risk than occupancy class J3 (see 5.7.3). It is therefore not a viable option for the storage of most dangerous goods.

7.5.3 Firefighting implications

7.5.3.1 Means of escape from, and access for firefighters to upper storeys are limited in an emergency.

7.5.3.2 In the upper storeys, escape and firefighting may be aided by the construction of outside balconies and fire escapes. In contrast, smoke and heat build-up can severely restrict access to, and escape from, the lower storeys.

7.5.4 Warehouse technology

7.5.4.1 A multi-storey warehouse is suitable for

- a) storage jobs with slow turnover, such as those in stockrooms and spare parts storerooms, and
- b) storage jobs related to other operating activities, such as the packaging materials warehouse in filling buildings or the commissioning warehouse in marshalling areas.

7.5.4.2 Columns and walls considerably limit the useful storage volume and the warehouse technologies that can be used.

7.5.5 Costs

As a result of the poor utilization of the enclosed volume and the expense involved in constructing load-bearing storage places, the capital and operating costs of a multi-storey warehouse are the highest of all types of warehouse construction.

7.6 High-rack warehouse

7.6.1 General

The high-rack warehouse is a single-storey building and is enclosed on all sides. It differs from the surface warehouse in that construction heights can be up to 45 m. The main elements of the high-rack warehouse are a solid floor or base plate, a rigid rack assembly of steel or concrete, and the roof and wall constructions, to which the rack assembly can be attached.

7.6.2 Products that may be stored

Since each individual storage unit has to be accessible, high-rack warehouses are economical only for large product ranges, coupled with the movement of large quantities and a high rate of stock turnover (more than ten times per year). Materials that do not represent a significant fire hazard may be stored, provided that the warehouse is equipped with overhead sprinklers. Additional safety features are, however, required for storage of most classes of dangerous goods; for example, explosion-prevention installations and forced ventilation are required for the storage of flammable liquids. It is important to note that small fire sections such as those required for a number of different storage classes cannot be economically realized in a high-rack warehouse.

7.6.3 Firefighting implications

When flammable and combustible materials are to be stored, the large warehouse capacity per fire section dictated by the system design requires that automatic extinguishing facilities be so installed as to allow the in-rack sprinkling of all storage places.

7.6.4 Warehouse technology

The storage racks are served by automatic rack servers on guide rails. The storage units have to be moved to and from the warehouse by special transportation facilities. Safety features that are likely to be required are

- a) profile checking of the storage units on receipt and during travel,
- b) automatic utilization control of the storage place before the load is deposited,
- c) automatic path monitors for longitudinal and vertical travel, including automatic cut-off, and
- d) automatic monitoring of stock movement to aid the deposition and removal of stock.

7.6.5 Costs

The capital costs per storage unit are relatively high, and are economically justified only when a high rate of turnover of high-value stock is required. When a high-rack warehouse is used in this way, the operating costs per stored unit can be low, resulting in overall costs that are comparable with those of other warehousing systems.

7.7 Special warehouse

7.7.1 General

A variety of special warehouse construction designs are available. As in the case of high-rack warehouses, the construction design is dictated by the required warehousing facilities; in most cases, the warehouse technology is mounted on a base plate which, in turn, supports the roof and wall assemblies.

7.7.2 Products that may be stored

The use of special warehouses is likely to be economical only when small product ranges (maximum ten articles) with a very high rate of stock turnover (at least fifty times per year) have to be stored in large quantities.

7.7.3 Firefighting implications

The type of firefighting equipment needed depends on the individual circumstances.

7.7.4 Warehouse technology

Goods transfer, with appropriate facilities for transport to and from the warehouse, is normally completely automatic. The most common special warehouses include the following:

- a) transfer warehouses for pallets, containers and sacks (bin bags);
- b) circulating warehouses, that use continuously operating horizontal and vertical conveyors; and
- c) stacking warehouses, such as empty-drum warehouses and container terminals.

7.7.5 Costs

The capital costs per storage unit are very high; economic efficiency is likely to be achieved only when goods turnover is very high.

8 Warehouse construction

8.1 General

8.1.1 Building design and construction shall comply with the relevant national building regulations (see foreword), relative to the occupancy class(es) of the building(s) concerned (see 5.7.3). Where the provisions of this clause conflict with those of the relevant national building regulations, the latter shall apply, except that where the provisions of this clause are more stringent than those of the National Building Regulations, the provisions of this clause shall apply.

This clause shall be read in conjunction with

- a) SANS 10400, and
- b) the relevant national regulations and statutory provisions dealing with the workplace environment (see foreword).

8.1.2 The design of the structural system of any building shall be carried out in accordance with SANS 10160 and in accordance with the relevant of the following standards:

- a) SANS 10100-1 and SANS 10100-2 (for structural concrete);
- b) SANS 10104 (for handrails);
- c) SANS 10137 (for glazing);
- d) SANS 10161 (for foundations);
- e) SANS 10162-1 and SANS 10162-2 (for structural steel);
- f) SANS 10163-1 and SANS 10163-2 (for structural timber); and
- g) SANS 10164-1 and SANS 10164-2 (for structural masonry).

8.1.3 The recommendations of SANS 10139 shall be taken into account with regard to the fire prevention and firefighting aspects of buildings.

8.1.4 An enclosed warehouse shall be substantially closed in, shall be lockable, and shall not have more windows or open spaces in the walls or roof than are necessary to provide an adequate degree of natural lighting (see 8.10) during the day and the necessary ventilation at all times (see 8.8.1).

8.1.5 Load-bearing construction elements, walls, floors, ceilings, doors and gates shall be made of non-combustible materials that are impervious to the dangerous goods to be stored.

NOTE Load-bearing roof components may be made of fire-retardant timber (see 8.5).

8.2 Frame

The frame of a warehouse shall be of concrete or steel. A steel frame used for an enclosed warehouse shall be fire protected to give the required stability.

8.3 Walls

8.3.1 External walls

External walls should preferably be of masonry construction or of metal (steel or similar) cladding. Aluminium cladding shall not be used.

NOTE The construction materials of external walls determine the safety distance to other buildings (see rule TT2 in SANS 10400:1990).

8.3.2 Separating elements

8.3.2.1 The fire resistance of each wall that acts as a separating element shall be at least

- a) 120 min in the case of a wall adjoining a storage area of occupancy class J1, and
- b) 60 min in the case of a wall adjoining a storage area of occupancy class J2 or J3 (see 5.7.3).

8.3.2.2 Subject to any more stringent provisions that could be necessitated by technical safety reasons, for example product separation and segregation needs, the areas of the divisions formed within a building by separating elements shall be such as to comply with the relevant provisions of SANS 10400.

NOTE See, in particular, rules TT3 and TT4 in SANS 10400:1990.

8.3.2.3 Separating walls shall be non-load-bearing and independent of the main structure of the building.

8.3.2.4 Where piping, ducting and electric cables penetrate a separating wall, they shall be either placed in fire-retardant sand cups or so sealed around as to prevent the spread of fire.

8.4 Floors and spillage containment

8.4.1 General

Floors, whether indoors or outdoors, shall be of concrete or of another material impermeable to liquids and impervious to the dangerous goods to be stored. Floors in storage areas shall be of sufficient load-bearing capacity to withstand the weight of stock, racking and any mechanical handling equipment to be used. Floors shall be smooth but not slippery (even when wet), free from cracks to facilitate cleaning, and so designed as to contain leakage and contaminated fire water by means such as a surrounding sill, kerb or bund wall.

8.4.2 Principles of spillage containment

8.4.2.1 Retention facilities have to be provided in stock warehouses (see also annex C), marshalling areas and loading zones to contain and to allow safe treatment of the following, before disposal:

- a) flammable, toxic or water-polluting liquids in the event of spillage or of shipping damage;
- b) firefighting water contaminated with products, in the aftermath of a fire; and
- c) contaminated rainwater, especially in uncovered storage yards, marshalling areas or loading zones.

8.4.2.2 A three-stage catch-basin arrangement is the most efficient means of spillage containment. It normally comprises the following:

- a) Primary basins, such as spill collection trays, located directly under the racks on which liquids are stored. The volume of each primary basin is determined by that of the largest storage unit in the rack above it. Because the primary basin is designed to catch undiluted product, its surface has to be resistant to the various products for lengthy periods.

NOTE 1 Sheet metal, metal or other foils, product-resistant paints or special-purpose resins are often used as surfacing materials for primary basins.

NOTE 2 Where drums are stored direct on the floor, a primary basin cannot be used; it might be necessary, however, to coat the floor with a product-resistant surface material.

- b) A secondary basin, which is provided to retain larger quantities of product when damage occurs, such as during a fire or major spillage. The secondary basin also has to contain firefighting water and, in the case of uncovered outdoor storage yards, marshalling areas and loading zones, rainwater. Because personnel will always be on the scene quickly to deal with the problem, the

surface of the secondary basin is generally not required to be resistant to products for lengthy periods.

NOTE This is not the case for all products; when, for example, chlorinated hydrocarbons are stored, the secondary basin will need to be protected in the same way as the primary basin, to prevent seepage through its surface and the subsequent pollution of ground water.

- c) A tertiary basin, which is provided to retain firefighting water and, in outdoor areas, rainwater. The tertiary basin is located outside the storage area. The contents of the secondary basin are pumped or allowed to flow under control into the tertiary basin for treatment and disposal; this facilitates the cleaning up of the storage area and the rapid resumption of normal operations. Generally, the tertiary basin is used rarely and for short periods. Because the concentration(s) of product(s) in the water diverted to a tertiary basin is/are low, tertiary basins are not required to be as watertight as secondary basins. Tertiary basins usually take the form of either reinforced concrete bunded areas, which may be surfaced with a resin or a foil, or ponds lined with a plastics material covered with sand or clay.

NOTE Under certain circumstances, the functions of the various basins can be combined into one catch basin. If this approach is adopted, it is necessary to ensure that the watertightness and product resistance of the surface, and the total retention volume of the single basin, reflect the most stringent requirements of an equivalent three-stage system, and that the single catch basin is located within the fire section in which the products are stored.

8.4.2.3 The size and design of retention facilities will depend on estimates, preferably based on a worst-case scenario, of

- a) the quantities and properties of goods likely to escape,
- b) the quantity of firefighting water or rainwater that will accumulate,
- c) the concentration of products in these waters, and
- d) the required retention time before appropriate effluent treatment and disposal can be accomplished.

8.4.3 Spillage containment in indoor storage areas and marshalling areas

8.4.3.1 All warehouse sections in which toxic substances or substances that are known to cause water pollution are stored shall have a floor that consists of a secondary catch basin of capacity at least 10 % of the total available storage volume in the warehouse section. Despite this provision, the kerb, sill or bund wall that forms the perimeter of the floor shall be effectively sealed against spills to a height of at least 250 mm above the warehouse floor level. Annex C gives further guidance in regard to "rules of thumb" that can be used to calculate realistic retention volumes.

NOTE See 12.13.4 for the actions to be taken in the case of leaking or broken containers.

8.4.3.2 Where flammable or corrosive substances are stored, the floor shall slope away from the storage area (primary collection area) to a secondary catch basin or sump of capacity at least 10 % of the total available storage volume of the fire section concerned. The secondary catch basin shall be within the fire section, and shall be such that it can be well ventilated. Care shall be taken in the design of such areas to prevent contamination of the soil or ground water.

8.4.3.3 Where possible, warehouse floors that are to be bunded shall be below ground level, to provide an in-built liquid retention capability. For warehouses constructed above ground level, however, special provision for spillage containment is necessary.

8.4.3.4 Concrete ramps, of apex height equal to that of the bund walls, and of a gradient not exceeding 1 in 10, shall be constructed across all external doorways of storage areas. Where space on the outside of the warehouse is restricted, a ramp may be constructed with its apex inside the warehouse; similarly, where space on the inside of the warehouse is restricted, a ramp may be constructed with its apex outside the warehouse. In either event, containment capability shall be retained by constructing appropriate additional bund walls on either side of the ramp. If the apex of a ramp is outside the warehouse, the roof shall be extended over the ramp to prevent the ingress of rainwater.

8.4.3.5 Warehouse sections that are used entirely for the storage of non-water-polluting solids do not require catch basins, provided that no water-polluting substances can be formed in the event of a fire.

8.4.3.6 Warehouse sections that are used entirely for the storage of non-water-polluting liquids should be provided with primary and secondary catch basins as a precautionary measure.

8.4.3.7 If primary and secondary catch basins are provided, they shall be part of a single fire section. Only the tertiary catch basin may be located outside the fire section.

8.4.3.8 The point(s) at which effluent could overflow from a secondary to a tertiary catch basin shall be well defined and controllable; an appropriate drainage system, such as one that uses a sump pump, shall be provided for emptying the secondary basin into the tertiary basin.

8.4.3.9 A flame propagation inhibitor shall be installed at overflow points when flammable gases or flammable liquids are stored.

8.4.4 Spillage containment in outdoor storage areas

8.4.4.1 Where toxic substances or substances that are known to cause water pollution are to be stored outdoors, spillage containment arrangements identical with those for indoor storage shall be provided.

8.4.4.2 To accommodate rainwater, outdoor bunded areas or ponds shall incorporate a drain controlled by a valve that shall be kept closed at all times except when rainwater is to be released (see 7.2.3).

8.4.4.3 Outdoor secondary and tertiary basins may be connected by means of open gutters or closed pipelines. Where flammable liquids are stored, however, closed pipelines shall be connected by means such as siphons or flame-arrestor gauzes, which prevent "flashback" of burning liquid.

8.4.5 Spillage containment in loading zones

8.4.5.1 Spillage containment arrangements are not required in traffic areas, such as streets, turning areas and parking places.

8.4.5.2 In the areas where loading or unloading is carried out, surface drainage shall be into a central collection pit along separate drainage lines or gutters. Loading and unloading areas shall slope with a gradient of approximately 2 % toward the drains or gutters. The collection pit should be capable of retaining at least one day's rainfall, and shall be connected to the stormwater drain by means of a valve, which shall be kept closed during normal operations. In a loading area, there shall be no drain that leads direct into a sewer or watercourse. Discharge from the collection pit into the stormwater drain may be carried out at the end of each shift or day's work, provided that no shipping damage or product spillage has occurred during working hours. If damage or spillage has occurred, the contents of the pit shall be disposed of under controlled conditions, for example either by pumping it into containers or by waiting until an analysis has shown the proposed discharge to be within permissible limits.

8.4.6 Cleaning

Provision shall be made for washing floors with water or with other cleaning materials, as appropriate to the nature of the goods stored.

8.5 Roofs

8.5.1 Roofs shall be such as to comply with the requirements of part L of SANS 10400:1990, they shall preferably be of pitched design, and shall be so designed as to permit the release of smoke and heat in the event of a fire.

NOTE The early removal of smoke and heat will improve visibility of the source of the fire and retard the lateral spread of the fire.

8.5.2 If roof insulation is used, it shall be of a non-combustible material, such as mineral wool or glass fibre.

8.6 Lightning protection and discharge of electrostatic charges

8.6.1 Adequate protection against lightning, in accordance with the relevant provisions of SANS 10313, shall be provided. Where explosive products are to be stored, the more stringent provisions of SANS 10313 for the protection of structures designed for the storage of explosives shall apply. Lightning protection systems shall be tested every three years.

NOTE See 19.1 and annex D.

8.6.2 In areas where flammable or explosive substances are stored, appropriate measures shall be taken to prevent the accumulation of electrostatic charges or to discharge these under controlled circumstances. The relevant provisions of SANS 10123 shall apply (see also 5.1.2).

8.7 Doorways and emergency exits

8.7.1 General

8.7.1.1 Sufficient entrance and exit doorways or openings shall be provided to enable normal warehousing operations to be carried out without compromising security.

8.7.1.2 All emergency exits shall be clearly marked.

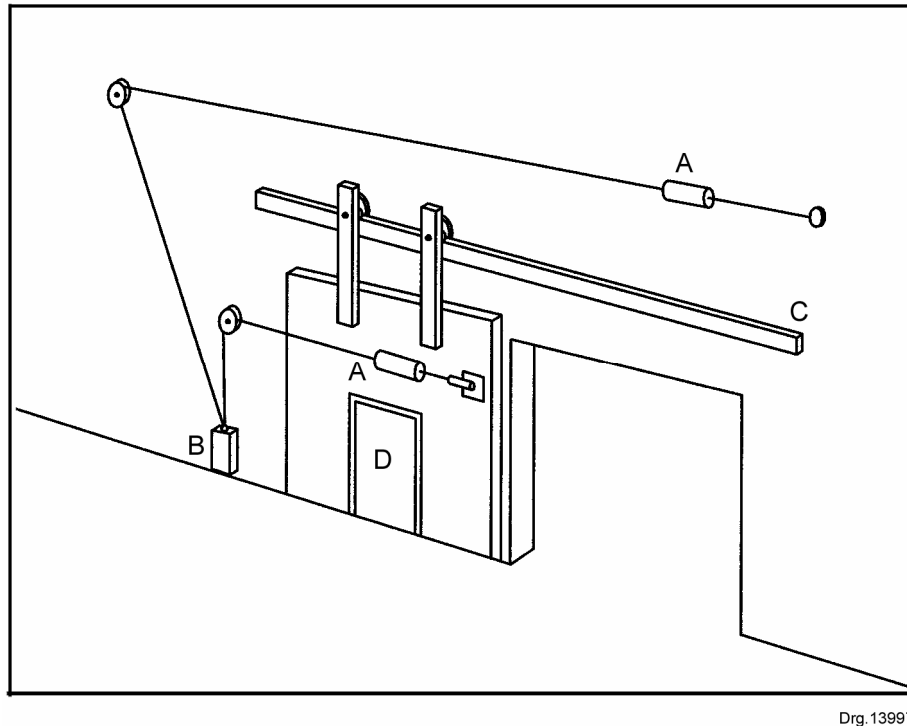
8.7.1.3 All exit doors shall be easy to open in the dark or in dense smoke.

8.7.1.4 Emergency exits shall be provided in addition to the main exits (see also 9.6).

8.7.2 Fire-doors

8.7.2.1 All openings in separating walls shall be fitted with self-closing fire-door assemblies of at least the same fire resistance as the wall itself, and that comply with the requirements of SANS 1253.

8.7.2.2 Doors provided for fork-lift truck access through separating walls shall be fitted with a fusible link or a link activated by an automatic fire detection system to ensure automatic closure of the door in the event of a fire. The space required for closure shall be kept free from obstruction. See figure 1 for an example of a typical arrangement.



Drg.13997

Legend : A: Fusible links. One link positioned over door frame so that heat/flame encroaching from storage area on far side of wall will activate it.

B: Counterweight. Cable passes through running eye on top of counterweight; it is not fixed to counterweight.

C: Inclined track.

D: Emergency exit of fire resistance equal to that of fire-door.

Figure 1 — Self-closing fire-door

8.8 Ventilation, air conditioning and heating

8.8.1 Ventilation

8.8.1.1 General

Every covered storage area shall be provided with either adequate natural ventilation or forced draught ventilation in accordance with Part 0 of SANS 10400:1990 that ensures at least five changes of air per hour. In general, poor ventilation occurs if vents are positioned near the floor, and good general ventilation occurs where vents are positioned both near the floor and near or in the roof. It shall be possible to shut off a forced draught ventilation system by means of a main switch in the event of a fire or the escape of poisonous or corrosive gases. Where highly flammable gases or flammable liquids are stored, effective extraction shall be provided, at or near floor level, and the ventilation shall be so efficient as to prevent the formation of an explosive atmosphere. A ventilation rate of up to 12 air changes per hour could be required in certain cases. Appropriate monitoring using an explosimeter is recommended. Where forced draught ventilation is applied, it shall operate continuously during periods of normal operation, and might even need to operate during periods when the warehouse is unmanned.

NOTE Forced draught ventilation systems might be required to be flameproof.

8.8.1.2 Smoke and heat ventilation

The following arrangements are appropriate for smoke and heat ventilation:

- a) natural lighting openings covered with domes or strips of a plastics material;
- b) automatically or manually opening exhaust shutters; and
- c) permanent ventilation openings in or near the roof.

The positions of all panels that can be opened in external walls shall be marked on the outside of the building, to permit easy identification by fire authorities.

Where the floor area of any room exceeds 500 m², certain minimum size requirements could apply to ventilation openings in order to comply with the relevant national building regulations (see foreword); alternatively, a mechanical smoke ventilation system could be required.

NOTE See, in particular, rules OO4 and TT42 of SANS 10400:1990.

8.8.2 Air conditioning and humidity control

8.8.2.1 Air conditioning shall preferably be of the ducted air type, with the air-conditioning plant situated well away from the storage area. Individual electric air conditioners shall not be used in areas where flammable materials are stored. Where it is necessary to humidify the storage area, this shall be done by direct spraying of steam or water vapour. Dehumidification could be required where a large quantity of substances that react violently with water are stored. Where room humidity is critical, appropriate monitoring shall be carried out.

8.8.2.2 Any air-conditioning system or artificial ventilation system in any building shall be so designed as to prevent the distribution of products of combustion in the event of a fire.

NOTE See, in particular, rule TT43 of SANS 10400:1990.

8.8.3 Heating

Where room heating is required to ensure product integrity, it shall be so designed as to ensure that the temperature in the warehouse does not fall below 5 °C. Heating systems shall preferably be based on hot water or steam, with the heat source and pipes, radiators or similar equipment that are likely to become hot, so positioned as to prevent direct heating of the stored product. Direct electrical room heating equipment, or portable gas-fired or oil-fired room heaters shall not be used in areas where flammable materials are stored. Where a maximum allowable temperature applies, appropriate monitoring systems shall be used. Facilities for heating a circulating medium shall be located outside the storage area or in a separate room. Where building insulation is used, it shall be of a non-combustible material such as mineral wool or glass fibre.

8.9 Water supplies and drainage

8.9.1 Water supplies

8.9.1.1 Potable water

Wherever practicable, potable water supplies shall be separate from firefighting water supplies (see Parts P and W of SANS 10400:1990).

8.9.1.2 Firefighting water

Firefighting water supplies shall be such as to permit the warehouse to comply with the provisions of 10.2.1.1.

8.9.2 Drainage

NOTE For further information on the drainage of uncovered and covered outdoor storage yards, see 7.2.3 and 7.3.3 respectively.

8.9.2.1 Open drains shall not be used in buildings in which toxic chemicals are stored.

8.9.2.2 Drainage of spilled product, water used for washing down the inside of the premises, firefighting water and the contents of bunded areas shall be by means of a collection pit or catch basin (see 8.4), from which the contents shall not be discharged unless analysis and appropriate treatment have shown the effluent to be within statutory limits. Direct drainage into stormwater drains or water courses is prohibited.

8.9.2.3 Gutters, downpipes and stormwater drains shall be provided for the removal of rainwater from the roof and outside areas. Downpipes should preferably be external but, if internal, they shall be non-combustible. Downpipes shall be protected against damage that could be caused by vehicles and pallets.

8.10 Lighting

8.10.1 Where warehousing operations are only carried out during daytime and natural lighting provides a sufficient level of illumination to ensure compliance with the regulations, artificial lighting need not be installed.

8.10.2 Artificial lighting shall be in accordance with SANS 10114-1, and shall be such that undue warming of products is avoided. Lights shall be located above entrances and aisles, and not above product stacks.

8.10.3 Wiring for electric lighting shall be in accordance with SANS 10142-1 and the necessary certificate(s) of compliance shall be obtained.

8.10.4 Where electric lighting is installed in a warehouse that is to be used for flammable or explosive products, it shall be protected in accordance with the relevant provisions of SANS 10108 for the class and division of hazardous location that the warehouse represents.

8.10.5 No switches may be installed inside a stock warehouse that is to be used for flammable or explosive products. Main switches shall be positioned outside the warehouse and shall be protected against the weather.

8.10.6 Subject to the provisions of 8.10.1, emergency lights shall be placed at strategic positions along escape routes. Each light shall have an independent power supply, such as a battery, which shall be kept fully charged during normal operations. Emergency lighting shall be so arranged that failure of the main supply will automatically switch on the emergency lighting.

8.11 Electrical equipment and installations, other than for lighting

8.11.1 All electrical installations shall be in accordance with SANS 10142-1 and the necessary certificate(s) of compliance shall be obtained. Only the electrical facilities that are absolutely vital for the operation of a warehouse may be located in the warehouse. (See also 8.10.5.) All electrical apparatus used shall be protected in accordance with the provisions of SANS 10108. All relevant provisions of SANS 10086-3 and SANS 10119 shall be complied with. When relevant, additional safety requirements of local authorities shall be complied with.

NOTE Insurers might also insist on additional safety requirements.

8.11.2 A separate electrical switch room shall be constructed. It shall be located against an outer wall of the warehouse building, and shall be separated from the storage area by walls that provide a fire resistance of 120 min. The door(s) that permit entry to the electrical switch room shall not open direct into the stock warehouse. A drainage system shall prevent the entry of water into the switch room. The main power line into the electrical switch room shall not pass through the storage area; it shall be laid either along the outside of the building or in earth and encased in concrete. Switching to back-up or emergency power supplies, including battery back-up supplies for alarm systems, or to independent default lines or power generators, shall be done either in the switch room or in a safe area well away from storage areas.

8.11.3 Wherever practicable, electrical equipment other than for permanent lighting, such as power points, power tools or hand lights, shall not be installed in a warehouse that is used for flammable or explosive products. Where such electrical equipment is used, it shall be protected in accordance with the provisions of SANS 10108 for the appropriate class and division of hazardous location that the warehouse represents.

8.11.4 Operating procedures shall provide for the isolation of non-essential electrical equipment during periods when the warehouse is unmanned.

8.11.5 Battery charging facilities for electrically operated fork-lift trucks should preferably be in an open-sided, covered area within the marshalling area. If this is not possible, the room or area in which they are kept shall be well ventilated at all times, without direct access from the stock warehouse. Vents in such a room or area shall be as high as possible in the walls, to prevent the accumulation of hydrogen gas. Electrical equipment in this room or area shall be protected in accordance with the provisions of SANS 10108 for the appropriate class and division of hazardous location that the room or area represents.

8.12 Racks, shelving and warehouse storage technology

Dangerous goods shall not be stored direct on the floor. Adequate racks and shelves shall be provided for small packages but, in general, provision shall be made to store goods on pallets or in standardized storage containers that, especially in the case of larger warehouses, can be more easily handled by fork-lift trucks. Racks and shelves shall be non-combustible. The warehouse storage technology to be installed will depend on the quantities, types and storage classes of products to be stored, the scale of the warehousing operation, the turnover rate and logistical and economic factors which are discussed in detail in 11.2.

8.13 Means of impeding the progress of a fire

Equipment such as fire shutters and draught curtains shall be installed as necessary and as recommended by the local fire authority. Where the design of the building necessitates it, a fireman's lift shall be installed.

NOTE Recommendations regarding these and other devices are given in SANS 10139.

8.14 External signs

8.14.1 At each entrance to a stock warehouse, the warning "Storage of dangerous goods – Unauthorized entry prohibited" shall be displayed in red letters against a white background. The warning notice shall be in one of the official languages and in at least one other language indigenous to the region. The height of the letters shall be at least 75 mm.

8.14.2 Where only one hazard class of dangerous goods (see 4.2) is stored in a warehouse, the relevant class diamond (see table 2) shall be displayed at each entrance. Where more than one hazard class of dangerous goods are stored, a "mixed load" diamond shall be displayed (see figure 2). The dimensions of the hazard class diamond shall be at least 250 mm x 250 mm.

NOTE See 9.7 for hazard warnings to be displayed inside a warehouse.

8.14.3 Symbolic safety signs shall comply with SANS 1186-1 and shall be used as necessary outside the warehouse to denote safety-related features of the premises, including the following:

- a) "no smoking", "no naked flames" and "no fires" restrictions and other specific hazard warnings;
- b) the positions and types of fire-related equipment (such as extinguishers, hose reels, hydrants, mains water supplies and alarm switches); and
- c) areas in which protective clothing or apparatus is required.

8.14.4 All panels that can be opened in the building walls shall be appropriately identified to permit easy identification by fire authorities.

8.14.5 All external signs used shall be relevant and appropriate, and shall be so positioned that they are

- a) clearly visible at all times,
- b) not subject to misinterpretation, and
- c) not subject to damage during normal warehousing operations.

Table 2 — Hazard class diamonds





1	2
Class, division or subsidiary risk	Hazard class diamond
1.1, 1.2, or 1.3	 <p>(See NOTES 1 and 2)</p>
1.4	 <p>(See NOTE 2)</p>
1.5	 <p>(See NOTE 2)</p>
1.6	 <p>(See NOTE 2)</p>
<p>NOTE 1 Insert the division for explosives (see SANS 10228), in the space marked * *. To be left blank if explosive is the subsidiary risk.</p> <p>NOTE 2 Insert the compatibility group (see SANS 10228), in the space marked *, denoted by a letter A to N (excluding I and M) and S as indicated in SANS 10228. To be left blank if explosive is the subsidiary risk.</p>	

Table 2 (continued)










1	2
Class, division or subsidiary risk	Hazard label
2.1	 
2.2	 
2.3	
3	 
4.1	
4.2	

Table 2 (continued)










1	2
Class, division or subsidiary risk	Hazard label
4.3	 
5.1	
5.2	   <p>(See NOTE 3)</p>
6.1	
6.2	
7	
<p>NOTE 3 The yellow label with the flame over the circle can be used in conjunction with the label with the red upper half and the yellow bottom half until 1 January 2011, from which time the use of the latter label will be obligatory.</p>	

Table 2 (concluded)





1	2
Class, division or subsidiary risk	Hazard label
7	
7	
8	
9	 Drg.492a-x



Figure 2 — Mixed load diamond

8.15 Roadways

8.15.1 Road layout

8.15.1.1 Roads shall be so laid out that they satisfy basic operational requirements (see 11.1.5) and provide ease of access for firefighting purposes. Vehicular entry to, or exit from, the premises for loading and unloading purposes should be possible without the need for U-turns; there should be no culs-de-sac.

8.15.1.2 A one-way system, with separate entry and exit gates, is recommended; where this is not possible, main access roads shall be capable of accommodating two lanes of traffic.

8.15.1.3 Where the approach of vehicles to and from a public highway is controlled by gates, the gates shall be set far enough back from the frontage to enable a delivery vehicle to be stopped clear of the highway.

8.15.1.4 Adequate turning room for large delivery vehicles shall be provided at junctions, and care shall be taken in designing the road layout, to avoid obstructing the vision of drivers. Main two-lane access roads shall be of width at least 6 m.

8.15.1.5 Roadways shall be well surfaced, well drained and well maintained.

8.15.1.6 Adequate lighting shall be provided where night operations are to be conducted. Where pipelines or cables are routed adjacent to roads, protective kerbing, warning posts or fencing shall be used to prevent accidental damage.

8.15.1.7 Road layout and markings shall be such that

- a) mobile firefighting equipment and fire services personnel can gain access to hydrants at all times,
- b) firefighting equipment can be used safely irrespective of the location of the outbreak of fire or the direction of the wind,
- c) all roads, exits and entrances to buildings, and access to firefighting equipment are unobstructed, and
- d) hydrants and other firefighting equipment can easily be seen from all directions.

NOTE The use of reflective material or paint is recommended, to facilitate visibility at night.

8.15.2 Traffic arrangements

8.15.2.1 Parking shall be prohibited on main access roads. Special parking areas shall be allocated for tankers and other vehicles that contain dangerous goods. Bulk tanker parking areas shall be so designed that a large spill will not endanger persons or buildings, can be contained on site and cannot drain direct into a water course.

8.15.2.2 Parking areas for private vehicles shall be situated on a part of the site that is remote and separated from operational areas.

8.15.2.3 Unauthorized vehicles shall be prevented from using the roads.

8.15.2.4 Appropriate road signs and warning signs shall be used where necessary; on large sites, the numbering or naming of roads is recommended.

8.15.2.5 All vehicles shall be prevented from entering areas in which the use of fork-lift trucks is prohibited (see 11.4.1).

8.16 Rail sidings

8.16.1 The provision and construction of rail sidings shall be in accordance with relevant national legislation (see foreword).

8.16.2 Where an overhead cable crosses a siding where rail wagons are loaded or unloaded, the system shall be so designed that the power supply can be switched off.

9 Fire protection measures

9.1 General

9.1.1 The passive aspects of safety and fire protection, namely the fixed and permanent features of the site, and the design and construction of the warehouse are so selected and disposed as to provide control of the progress of an emergency and protection of the occupants of the warehouse in the event of an emergency. Active measures to be taken by the warehouse controller in the provision of safety and fire detection facilities are covered by 9.2 to 9.8.

9.1.2 The behaviour of a fire occurring anywhere in a warehouse and the response from people thus put at risk have to be anticipated. Individual provisions of this standard applied in isolation might give little or no benefit, and could even reduce the level of fire safety. For maximum benefit, all the relevant provisions of this standard need to be applied.

NOTE 1 Firefighting itself is covered in clause 10 of this standard.

NOTE 2 Detailed recommendations for the prevention, automatic detection and extinguishing of fire in buildings are given in SANS 10400 – T.

9.2 Fire alarm systems

9.2.1 When so required by the authority administering this standard, a warehouse shall be equipped with a fire alarm system that is audible throughout the premises, and that automatically relays a signal to the local fire authority. Where a security function or control centre is manned outside normal working hours, the triggering of the fire alarm shall be sufficiently audible or perceptible to alert the appropriate personnel immediately. Where an alarm is electrically powered, the power supply shall be uninterruptable.

9.2.2 For the purpose of identifying the location of the origin of a fire alarm signal, a large warehouse shall, as necessary, be subdivided into fire zones. The subdivisions shall be decided in consultation with the local fire authority, taking into consideration fire sections (see 11.1.2.2), smoke reservoirs, designated escape routes and the fire routine (see 10.3). The triggering of a fire alarm in one fire zone shall be audible simultaneously throughout the entire premises.

9.2.3 Manual alarm switches shall be provided throughout a building that is fitted with a fire alarm system. In addition, automatic detectors (see 9.3) shall be provided to detect the occurrence of fire and to initiate the operation of other automatic fire control equipment such as smoke ventilators and automatic fire-doors. The design of the fire alarm system, including the number and positions of manual alarm switches and detectors, shall be approved by the local fire authority before warehousing operations start, and shall be reviewed annually.

9.2.4 Provision shall be made for the operation of an evacuation signal (which may be the same as the fire alarm signal) throughout one or more fire zones or throughout the entire premises.

9.2.5 The installation, testing and maintenance of automatic fire detection and alarm systems shall be carried out in accordance with SANS 10139.

9.3 Fire detection systems

9.3.1 General

Fire detection systems give an early warning that a fire has started, and are particularly useful when premises are unoccupied. To be effective, however, they should be of a design appropriate for the area in which they are to be used, their reliability should be such as to minimize the incidence of false alarms, and they should trigger an appropriate firefighting response. In practice, such systems are of little value unless they are linked to a control room or to the fire authority direct. The specific items of fire detection equipment to be installed shall be decided in consultation with the local fire authority.

9.3.2 Types of fire detector

9.3.2.1 Smoke detectors

Smoke detectors are based on either the "ionization" principle or the "optical" principle.

Ionization detectors contain a small amount of radioactive material, and identify small particles in smoke. They are particularly prone to giving false alarms where powders are stored or handled, or where the general environment is dusty.

Optical detectors rely on a light beam's being disturbed by smoke particles. They are generally more suitable for use in chemicals warehouses than ionization detectors, although optical detectors can give false alarms if sited where thermal turbulence can occur.

Smoke detectors are particularly ineffective in the case of fires caused by overloaded electrical circuits, escaping gas, violent explosions, and poor storage of flammable rags or liquids, and will not detect fire if sufficient smoke is prevented from reaching the detector. Smoke could be prevented from reaching the detector if the fire is too far away, for example on another floor, behind a closed door, in a wall cavity, or if the prevailing air draughts carry the smoke away. The installation of smoke detectors on both sides of a closed door, and the installation of an interconnected "battery" of smoke detectors, greatly improve their effectiveness. Smoke detectors installed near ducted air outlets of air-conditioning systems are of great value in providing early warning of fire.

9.3.2.2 Heat detectors

Whether heat detectors are suitable in a given warehouse application will depend on the nature of the goods stored and the anticipated response time of firefighting teams. Various types of heat detectors are available:

- a) maximum temperature detectors, which give an alarm when a certain pre-set maximum temperature is reached;
- b) differential thermal detectors, which react to a certain increase in temperature per unit time;
- c) infrared heat detectors; and
- d) ultraviolet flame detectors.

9.4 Communications with the emergency services

9.4.1 Ongoing liaison shall be maintained with the local fire authority in terms of emergency planning (see clause 16) and, in the case of a large warehousing operation that has its own fire brigade, with regard to the manning, equipping and training of that brigade (see also 13.2.3(k)).

9.4.2 Hospitals and clinics or medical centres nearby shall be informed of the nature of materials stored, and their co-operation requested in making preparations for emergency treatment, should the need arise. Where the nearest hospital is a considerable distance away, doctors practising near the warehouse shall also be informed. Such contact with medical professionals shall be ongoing, and the information provided to them shall be updated at regular intervals.

9.4.3 Local medical, traffic and police authorities shall be requested and allowed to contribute to emergency planning (see clause 16) and shall receive copies of the emergency plan.

9.4.4 At the discretion of the warehouse controller, and depending on the products stored, appropriate information shall be provided to the local Poison Information Centre; such information shall be updated as necessary, and shall not be allowed to become obsolete.

9.4.5 Telephone communication with the emergency services from the central control room or security gatehouse shall be independent of other telephone traffic.

9.5 Communications with occupants of the premises

9.5.1 Where the scale of the operation and the logistics of evacuating the premises demand it, a public address system shall be installed in the warehouse, to facilitate evacuation and the giving of instructions in an emergency. The public address system shall be operated from a central control point.

9.5.2 Public address facilities shall include arrangements for making separate announcements in different parts of the building, if so required.

9.5.3 In every part of the building, the volume of emergency announcements made over the public address system shall be at least 5 dB(A) above the ambient background noise level.

9.6 Escape routes

Escape routes shall be planned in consultation with the local fire authority in accordance with TT16, TT19, TT20 and TT21 of SANS 10400:1990. Consideration shall be given to the type and location of all conceivable emergencies. All employees shall be informed of escape routes. In general, there shall be at least two escape routes from any enclosed location in a warehouse. The number of possible escape routes from a given location shall be a reflection of the degree of danger associated with that location. Escape routes shall make use of normal entry and exit points, and also of emergency exits. As a general rule, breathing apparatus, masks, emergency showers and first-aid boxes shall be located along escape routes (in addition to those required in operational areas). To facilitate escape, escape routes shall be safeguarded against the ingress of smoke; appropriate means of smoke ventilation might be required (see 8.8.1.2).

9.7 Safety signs, information signs and marking inside the premises

9.7.1 Symbolic safety signs that comply with SANS 1186-1 shall be used within the warehouse to denote safety-related features of the premises, including the following:

- a) "no smoking", "no naked flames" and "no fires" restrictions and other specific hazard warnings;
- b) the positions and types of fire-related equipment (such as extinguishers, hose reels, hydrants, mains water supplies and alarm switches);
- c) areas in which protective clothing or apparatus is required;
- d) first-aid stations, equipment and apparatus; and
- e) emergency exit routes and other directional information.

9.7.2 Every type of storage area inside a warehouse shall be clearly demarcated, for example separate storage areas for poisons, flammables and corrosives shall display the relevant hazard class diamond (see table 2). The dimensions of the hazard class diamonds shall be at least 250 mm x 250 mm.

NOTE 1 Segregation and separation of the different classes of goods are covered in 12.8.

NOTE 2 The marking and labelling of the packaging of dangerous goods are covered in SANS 10229-1.

9.7.3 All safety signs used shall be relevant and appropriate, and shall be so positioned that they are

- a) clearly visible at all times,
- b) not subject to misinterpretation, and
- c) not subject to damage during normal warehousing operations.

NOTE See 8.14 for hazard warnings to be displayed outside a warehouse.

9.7.4 Information and marking, in the appropriate formats necessary for a safe and efficient warehousing operation, shall be provided, for example

- a) marking that indicates which classes of goods are permitted to be stored in each area,
- b) storage area marking, and
- c) floor marking that designates storage areas and traffic, escape and rescue routes.

9.7.5 All employees shall be trained in the meaning of all safety signs, information signs and marking (see 13.2 and 14.6), and records of such training kept.

9.8 Other technical safety features

9.8.1 Depending on the products stored and the technical requirements of the warehouse, some of the following additional features may be required:

- a) sensors that provide early detection of escaping products, such as

- 1) electrochemical cells for the detection of hydrogen disulfide, hydrogen cyanide, phosgene, chlorine, carbon monoxide, sulfur dioxide and ammonia,
 - 2) colorimetric instruments such as aerosol trace gas monitors or paper-strip indicators for the detection of phosgene, cyanogen chloride, hydrochloric acid, hydrofluoric acid, ammonia, hydrazine and isocyanates, and
 - 3) analytical light barriers for the detection of chlorine and phosgene;
- b) sensors that detect fire or explosion hazards, for example
- 1) semi-conductor sensors,
 - 2) catalytic differential thermal detectors,
 - 3) flame-ionization detectors,
 - 4) electrochemical cells, and
 - 5) paramagnetic devices;
- c) facilities for detecting the escape of water-polluting materials, such as gas-measuring instruments and fill-level monitors in bunded areas; and
- d) means of providing early detection of energy or utility failures, for example
- 1) potential monitors for power failure,
 - 2) pressure monitors for steam failure,
 - 3) pressure monitors for failure of nitrogen or air supplies,
 - 4) temperature and pressure monitors for refrigeration failure, and
 - 5) pressure monitors for water failure.

9.8.2 Appropriate technical safety features, such as those outlined above, shall be installed as necessary. However, for effective monitoring, a combination of technical devices and regular physical checking, for example regular tours of inspection, shall be used.

9.8.3 Some substances could, in the event of a fire, release toxic compounds into the air or contaminate run-off water. In such cases, provision shall be made for external means of aiding and ensuring the complete combustion of such products and, if necessary, of the warehouse itself, should the person in charge of operations at the time of a fire consider it necessary. A simple example of such combustion means would consist of a fuel tank that contains diesel fuel (situated well away from storage areas) and that has a means of delivering the fuel to the scene of the fire and a means of blowing air into the fire. Generators would, in the absence of mains power, provide power to electrical pumps or blowers. The exact design of any such facility shall be as agreed upon between the warehouse controller and the local fire authority.

NOTE Insurers should be consulted on the implications of such an arrangement.

10 Firefighting

10.1 General

10.1.1 Fire detection systems (see 9.3) and portable and fixed firefighting equipment shall be installed

- a) in the quantities and types necessitated by the products stored,
- b) as required by the local fire authority, and
- c) as necessary to enable the warehouse to comply with the National Building Regulations (see SANS 10400 and foreword).

10.1.2 Where the scale of operations permits, a warehouse shall have its own fire brigade. Otherwise, certain appropriately trained employees shall be delegated to take charge of initial fire fighting, pending the arrival of the fire authority. In any event, arrangements shall be put in place that will ensure (during periods when the warehouse is manned) an appropriate response to a fire between the initial raising of the alarm and the arrival of the fire authority. Firefighting should preferably start within 5 min of the triggering of the alarm when the warehouse is manned, and within 15 min of the triggering of the alarm when the warehouse is unmanned.

10.1.3 If the warehouse is not continuously manned, consideration shall be given to the installation of automatic sprinkler systems (see also 9.3.1).

10.1.4 If the response time of the local fire authority is likely to exceed 15 min, more comprehensive fire protection measures will be necessary than might otherwise be the case. For example, in a small warehouse, where the response time of the fire authority is less than 15 min, a "first-aid" type of firefighting system based on portable or mobile dry powder, foam or carbon dioxide extinguishers might be sufficient. In contrast, in a larger warehouse where such a response time cannot be guaranteed, the installation of an automatic sprinkler system and a full hydrant system with foam injection equipment is likely to be essential.

10.1.5 A fire routine that lays down actions to be taken by employees in the event of a fire, shall be drawn up and posted at appropriate places within the premises. All employees shall be trained in the fire routine, and regular fire drills shall be held, with records kept.

10.2 Firefighting equipment and media

10.2.1 Scale of firefighting equipment

10.2.1.1 The required water supply rate, the capacities (where relevant) of reservoirs, and the quantities and types of firefighting equipment installed, shall be as agreed upon between the warehouse controller and the local fire authority, bearing in mind the minimum requirements for fire sections (see annex B), product-specific requirements and the need to cool nearby buildings. Where possible, a contingency allowance of an additional 25 % of calculated requirements shall be made.

10.2.1.2 A warehouse in which any one of the following storage limits is exceeded shall be equipped with a hydrant system in addition to portable or mobile extinguishers:

- a) 30 t of flammable toxic or combustible toxic materials;
- b) 100 t of flammable materials; and
- c) 250 t of combustible materials.

NOTE A hydrant system may, nevertheless, be prescribed for a warehouse that stores smaller quantities of such materials, after other risk factors have been taken into account.

10.2.1.3 The firefighting water supply shall be such as to ensure an adequate response to all conceivable fires, and shall have a continuous flow rate of at least 1 200 L/min per hydrant in small warehouses. In larger warehouses in which highly flammable substances are stored and that are equipped with automatic sprinkler facilities, a capacity in the range 3 200 L/min to 6 000 L/min is likely to be required. Where it is necessary to achieve the required capacity, existing water supply systems shall be supplemented by water from a reservoir or firefighting pond. In all cases, the water supply shall be capable of being maintained for at least 120 min.

10.2.2 Fire installations

10.2.2.1 The relevant requirements of the National Building Regulations (see foreword and Part W of SANS 10400:1990), with the exception of those provisions given in more stringent form below, shall be complied with.

10.2.2.2 Water shall be supplied at hydrant outlets at a running pressure of 1 MPa at the required flow rate. Appropriate fire pump connections shall be provided as necessary to enable the water reticulation system to achieve the necessary pressure.

10.2.2.3 Hydrant mains shall be buried, and shall withstand all anticipated vehicular traffic, including fire tenders and delivery vehicles. Except where fittings of larger diameter are required in terms of 10.2.2.4, all components of hydrant assemblies up to the outlet connection shall comply with the relevant requirements of SANS 1128-1.

10.2.2.4 Risers shall be spaced not more than 90 m apart, and sufficient hydrant outlets and hose connections shall be provided to meet the needs of any potential fire area. In particular, sufficient hydrants shall be provided to enable all parts of the building to be within 15 m of a foam branch pipe that uses no more than 60 m of hose. Hydrants that serve high-fire-risk areas should preferably be of the four-headed pillar type, with risers of nominal diameter at least 100 mm. Hose couplings, connectors, and branch pipe and nozzle connections should comply, where possible, with the relevant requirements of SANS 1128-2. Where couplings are not compatible with the local fire authority's equipment, a sufficient number of the necessary adaptors shall be provided. Regular checks shall be carried out to ensure that such adaptors remain in their designated storage places; missing adaptors shall be replaced immediately.

10.2.2.5 Hydrant outlets and hose connections shall be so sited that they are easily accessible, and between 15 m and 30 m away from the most likely fire areas.

10.2.2.6 Mains shall be equipped with isolating valves so spaced that no damage or repair to the pipe system (exclusive of arteries) necessitates the shut-down of a section of pipe that will have the effect of reducing the total water supply capability by more than 25 %.

10.2.2.7 Each hydrant shall be equipped with at least two fire hoses each of length at least 23 m and an appropriate branch.

10.2.2.8 Equipment in the form of foam branch pipes, mobile foam units or foam cannons shall be provided as necessary, having regard to the risk and to anticipated foam application rates, and in consultation with the local fire authority. Foam supply shall, in general, be from the floor level upwards. Where it is deemed necessary by the local fire authority that foam tanks be installed above the stored product, provision shall be made to ensure that adequate volumes of foam can be injected into the tanks; foam injection systems shall be operable from outside the area where products are stored.

10.2.2.9 Automatic sprinkler systems, water or foam spray flooding systems, and automatic or manual powder-based and gas-based (for example halon, carbon dioxide, nitrogen) extinguishing systems shall be installed as necessary, having regard to the nature of the products stored. For environmental reasons, halon-based extinguishing systems shall be used only where there is no other practicable alternative extinguishing medium. Rooms protected by powder-based or gas-based systems shall be such that the extinguishing medium cannot escape from the room; the automatic closing of room openings and the automatic switching off of ventilation facilities prior to actuation shall be ensured.

10.2.3 Fire extinguishers, fire hose reels and mobile firefighting equipment

10.2.3.1 Fire extinguishers shall be selected for each location in the type(s) and size(s), and containing the extinguishing media, recommended by the local fire authority.

NOTE See SANS 1089-1 for recommendations in this regard.

10.2.3.2 Extinguishers, fire hose reels and delivery hose shall comply with the relevant SANS standard (SANS 543, SANS 1456-1 or SANS 1910). Extinguishers shall be installed, maintained and serviced in accordance with SANS 10105-1 and SANS 10105-2, as required by regulation T2 of SANS 10400:1990. Extinguishers shall be recharged or replaced before they reach their expiry dates, and hoses shall be inspected at intervals of not more than six months. Each hose shall be pressure tested at a pressure of at least 1,5 MPa after each use and at least once per year. Hoses that are found to be defective shall be replaced or repaired. Appropriate documented records shall be maintained for all tests, and routine tests shall be included in the schedule of routine safety checks referred to in clause 19.

10.2.3.3 Dry chemical powder used in fire extinguishers shall be of the multipurpose and foam compatible type, and shall comply with the relevant requirements of SANS 1522.

10.2.3.4 All fire extinguishers and delivery hoses shall be sited and stored in easily accessible, conspicuous locations and in such a way that they are protected from the weather. General purpose extinguishers shall be located as near as possible to exits from the building. Where large, undivided floor areas necessitate the positioning of extinguishers at intermediate points away from exits or outer walls, they shall preferably be installed along escape routes. General-purpose extinguishers shall be spaced not more than 30 m apart; extinguishers for special risks shall be disregarded in the application of this provision. Where a special risk exists, the appropriate extinguisher shall be placed close to the risk, for example a carbon dioxide extinguisher shall be located in close proximity to a battery charging unit.

10.2.3.5 Where hose reels are installed in a building, every part of the interior of the building shall be within reach of the discharge from at least one hose reel.

10.2.3.6 Water monitors, foam cannons or combination water-foam units, whether of the portable hand-operated type, the howitzer type or the trailer-mounted type, shall be stable when operated at pressures of up to 1 MPa and shall be capable of being elevated to an angle of at least 75° above the horizontal. The inlets of these units shall be provided with non-return valves.

10.2.4 Firefighting media

10.2.4.1 General

Subclauses 10.2.4.2 to 10.2.4.5 (inclusive) give brief descriptions of the modes of action and the uses of various materials likely to be recommended for use in combating or preventing the spread of fire. In a standard of this nature it is impossible to lay down specific provisions for all sets of circumstances. In many cases, foam will be the medium of choice, owing to the limited amount of (possibly contaminated) effluent it produces, and the limited amount of damage it causes to bagged stock, etc. The exact combination of firefighting media prescribed for each individual warehouse will, however, depend on a full risk assessment.

10.2.4.2 Water

10.2.4.2.1 Water is a coolant that reduces the temperature of a burning product to a point below its fire point and hence extinguishes the fire. Owing to the large heat transfer required, water is less effective than foam as an extinguishant for products of low flash points; the use of foam is therefore recommended for such products.

10.2.4.2.2 Water should generally be used as a fine spray or fog rather than as a jet; this both enhances its cooling potential and helps to prevent the fire from spreading.

10.2.4.2.3 In addition to its use as an extinguishant, water is a valuable aid in minimizing the spread of fire by cooling adjacent facilities or buildings.

10.2.4.2.4 Care shall be taken when large quantities of water are being used for warehouse fires that involve toxic substances, because of the danger posed by contaminated run-off. Water shall not be used on water-reactive chemicals such as calcium carbide, isocyanates, calcium oxide, certain halogenated compounds, such as acetyl chloride and aluminium chloride, and highly reactive metals such as sodium, potassium and calcium. Special storage risks for chemicals such as these shall be discussed in detail with the fire authority.

10.2.4.3 Dry chemical powders

Dry chemical powders that comply with SANS 1522 are generally effective on

- a) flammable solvents,
- b) pesticides (see SANS 10206) and other toxicants,
- c) aerosols,
- d) products that react with water, and
- e) electrical fires.

Dry chemical powders are, however, normally only used in portable or mobile extinguishers for dealing with small fires and so, although they are of considerable value, are regarded essentially as "first-aid" extinguishers.

NOTE One factor that is often overlooked when dry chemical powder extinguishers are being used on small fires is that their cooling effect is often negligible; residual flammable solvents might re-ignite after the initial fire has been extinguished.

10.2.4.4 Carbon dioxide

Carbon dioxide extinguishers are generally effective on

- a) flammable solvents,
- b) toxicants,
- c) products that react with water, and
- d) electrical fires.

As in the case of dry chemical powders, carbon dioxide can only be used as a "first-aid" extinguishant.

10.2.4.5 Foam

10.2.4.5.1 Provided that the correct grade is selected, foam is a particularly appropriate medium for fighting chemicals fires because

- a) it can be generated in large quantities and hence can be used to fight major fires,
- b) it is equally effective on products of high or low flash point, and
- c) it minimizes problems associated with run-off.

10.2.4.5.2 Because they contain water, foams shall not be used on electrical fires or on fires involving water-reactive products.

10.2.4.5.3 Foams can be subdivided into two main types:

- a) Foams for use on fires involving water-immiscible products such as petrol, oils and hydrocarbons. Some of these foams (for example, fluoroprotein foams) are unsuitable for fires involving water-miscible products, because they break down on contact.
- b) Alcohol-resistant foams developed for use on fires involving water-miscible products, such as alcohols, ketones and pesticides. These foams, of which the most effective are the synthetic aqueous film forming foams (AFFF), can also be used successfully on fires involving water-immiscible products.

10.2.4.5.4 In a warehouse that stores both water-miscible and water-immiscible products, only alcohol-resistant foam (see 10.2.4.5.3(b)) should be stocked and used for chemicals fires, unless the local fire authority advises to the contrary. In this way, the carrying of dual stocks of foam can be avoided. Where more than one type of foam concentrate is stocked, all foam concentrate containers shall be clearly marked to indicate their contents, and stocks of different foam concentrates shall be stored separately from one another. Foam concentrate shall comply with either ANSI/NFPA 11 or, where the situation so warrants and the local fire authority so advises, another approved standard.

10.2.4.5.5 Alcohol-resistant foams in general

- a) are incompatible with other foams in the concentrate form but, once generated, are compatible with other foams,
- b) are compatible with dry chemical agents,
- c) can be generated using fresh or salt water,

- d) are suitable for use on hydrocarbon solvents,
- e) are stable in the generated form, and
- f) require to be stored above about 2 °C, to prevent freezing.

10.2.4.5.6 While foam concentrates have a fairly long shelf life, it is essential to maintain records of purchase and expiry dates. Stocks shall be tested regularly and expired stocks shall be replaced.

NOTE Just-expired, or expiring, stocks can conveniently be used in fire drills.

10.2.4.5.7 Required stocks of foam concentrate shall be calculated, assuming a foam application time of 20 min, from a knowledge of

- a) the maximum applicable induction rate,

NOTE This is normally about 6 % (by volume) for polar solvents, although alcohol-resistant foams are now available for which a 3 % (by volume) induction rate is recommended. A reduction in the induction rate can have a beneficial effect on the costs of foam stocks, system design and storage facilities.

- b) the maximum application rate required for the worst-case scenario (for example, in the case of polar solvents this is likely to be in the region of 7 L/m²/min), and

- c) the maximum surface area of the fire likely to be encountered.

10.2.4.5.8 The stocks of foam concentrate shall be held as follows:

- a) at least 200 L, split between two locations in each building (for example in cabinets with hoses, branch pipes and nozzles); and
- b) the balance within a 2 min walk of the anticipated fire area.

10.2.4.5.9 In warehouses where the storage area of products exceeds 200 m², the calculated quantity of foam concentrate to be held may be reduced, subject to the approval of the local fire authority, but the minimum quantity held shall be at least equal to the calculated quantity required for the 200 m² of storage area that presents the highest foam requirement.

Note Insurers should be consulted on the implications of such an arrangement.

10.2.4.5.10 In warehouses where the storage area of products exceeds 1 500 m², and where such a reduction in stocks of foam concentrate is permitted, serious consideration shall be given to the holding of back-up stocks of concentrate at a location situated within a 10 min drive. When circumstances permit, mutual foam concentrate purchasing and sharing arrangements should be made with other operators in the area with regard to back-up stocks.

NOTE Insurers should be consulted on the implications of such an arrangement.

10.3 Fire routine

10.3.1 General

10.3.1.1 The fire routine shall be documented in the following formats:

- a) as a separate operating procedure (see 13.2);
- b) as part of a booklet of safety instructions (see 13.2.3(I)) or SDS; and

- c) in abridged form, as a poster, which shall list the main actions to be taken by employees in the event of a fire or on hearing an alarm, and which shall be displayed prominently in conspicuous places (for example on notice boards) throughout the premises.

10.3.1.2 Evacuation instructions shall form part of the fire routine. Where the scale of operations permits, fire marshals shall be appointed for each area of the premises, and separate assembly points shall be designated in safe areas, at which employees are to congregate following evacuation.

NOTE This type of arrangement facilitates roll calling, and hence provides an early indication of persons who are unaccounted for.

10.3.2 Action to be taken immediately

In the event of a fire, the following shall be done immediately and, as far as possible, simultaneously:

- a) sound the alarm;
- b) clear the immediate affected area of all personnel, except those actually involved in dealing with the fire;
- c) call the fire authority; if an automatic alarm call is thought to have been transmitted, ensure that this has been received and that assistance is on the way;
- d) ensure that senior staff and other designated personnel are aware of the situation;
- e) consider the need for evacuation of the premises and act accordingly;
- f) make arrangements for in-house and, as necessary, local medical personnel and authorities to be advised and asked either to attend or to stand by;
- g) hold a roll call to establish whether all personnel are accounted for;
- h) ensure that all firefighters are aware of the dangers from fumes, smoke, run-off and debris, and are equipped, as necessary, with full waterproof protective clothing and self-contained breathing apparatus;
- i) attack the fire; try to extinguish it if possible, and to prevent it from spreading to adjacent facilities; and
- j) if it is deemed likely that run-off will not be controlled, inform water and health authorities.

NOTE See also 18.2, which details actions to be taken following the extinguishing of a fire.

10.4 Firefighting technique

When a fire is being fought, the following techniques should be used:

- a) Work only from the upwind side, and work as far away as is practicable from the seat of the fire, in case there is an explosion.
- b) Do not enter an enclosed building or a smoke-filled area unless wearing the correct self-contained breathing apparatus.

- c) Avoid eating, drinking or smoking during firefighting; these actions increase the effect of exposure to toxic substances.
- d) Fight the fire with water, foam or dry powder. If only water is available, use it as a fine spray or fog. Do not use water jets.

CAUTION — Apply the requirements in 10.2.4.2.

- e) Cool adjacent facilities with water.
- f) Ensure that water and spilt product are being contained.
- g) If run-off occurs, or dangers arise from exploding containers, consider withdrawing and allowing the fire to burn out.
- h) Ensure that any person exposed to fumes, smoke or splashing, and any person showing signs of illness, dizziness or unusual behaviour is relieved of duty and placed under medical care, and that contaminated clothing is removed immediately.
- i) When the fire has been extinguished, clean up the site in accordance with 18.2 and ensure that waste is disposed of in accordance with 18.1.

10.5 Fires involving toxicants

10.5.1 In large fires involving pesticides (see SANS 10206) or other toxic products, the best course of action may be, under certain circumstances, to allow the fire to burn out rather than to extinguish it (see 9.8.3). If this course is adopted, the risk of environmental pollution due to contaminated run-off and problems associated with incomplete combustion of the toxic compounds will be minimized.

10.5.2 A decision to allow such a fire to burn out shall only be taken after due consideration of the following risks:

- a) whether the spread of the fire can be contained, and whether the engulfment of adjacent buildings, facilities or product stocks can be prevented; and
- b) whether firefighters engaged in cooling adjacent facilities will be exposed to unacceptable levels of danger.

10.5.3 If such a decision is taken, the cooling effect due to initial firefighting efforts might be such that the toxic compounds involved are unlikely to decompose completely during the remaining natural life of the fire. Active promotion of the fire, using equipment and fuel as referred to in 9.8.3, might be required. The possibility of such a situation arising shall be considered in the emergency planning stage (see clause 16) and, when relevant, the necessary equipment and fuel supplies shall be made available.

11 Warehouse organization and warehouse technology

11.1 Separation of functional areas

11.1.1 General

A warehouse shall be separated into the following functional areas:

- a) stock warehouse;
- b) marshalling area; and
- c) loading zone.

11.1.2 Stock warehouse

11.1.2.1 The stock warehouse is the area in which products are stored. It differs from the other functional areas in that

- a) it is an area of greater hazard potential owing to the nature, quantity and storage density of the stock,
- b) admission of visitors and non-company personnel is strictly regulated,
- c) equipment and facilities are oriented towards the products and their handling, and
- d) its structure is determined by the most economical warehouse and safety technology, and that has regard to the products stored.

11.1.2.2 The stock warehouse shall be separated into sections as necessary to satisfy requirements for

- a) maximum storage quantity of a product in a fire section,

NOTE Maximum permissible storage quantities per fire section, of products of each SANS 10228 class, are laid down in annex B.

- b) separation of products based on firefighting needs, and
- c) segregation of products of different classes.

NOTE See 12.8 for further information on product separation and segregation.

11.1.2.3 Separation into sections shall be achieved by the use of

- a) separating elements, to create fire sections,
- b) fire-resistant walls or separating elements, for product separation within a fire section, and
- c) product-separating walls or safety gaps, for product segregation within a fire section.

11.1.2.4 The individual sections of a stock warehouse could differ in terms of their construction and the warehouse technology and safety technology applied; these will depend on the nature of the products stored. For certain products, dedicated stores are required in terms of legislation.

11.1.3 Marshalling area

11.1.3.1 The marshalling area could include some or all of the following:

- a) areas for the receipt, checking and marking of goods;
- b) rooms for filling, re-packaging and re-formulation;
- c) areas for commissioning work;
- d) areas for the packaging and marking of goods for shipment;
- e) areas for preparation for shipment;
- f) offices and social rooms;

g) ancillary accommodation, such as supplementary rooms for electrical switching, central sprinkler controls, heating, air conditioning and ventilation; and

h) battery-charging stations (see 8.11.5).

11.1.3.2 The marshalling area differs from the stock warehouse in that it

a) receives a significantly smaller quantity of products per square metre, and therefore represents a lower specific fire hazard,

b) requires a lower room height,

c) is a continuous workplace, and

d) needs to accommodate, on a temporary basis, products in the goods receiving and shipment preparation areas which are not permitted to be stored or transported together (see 17.9 and 17.10).

11.1.3.3 The various rooms or areas within the marshalling area shall be separated in accordance with their functions and sizes, as follows:

a) receipt and shipment preparation areas, if adjacent to one another, shall be separated by a separating element; they shall, however, preferably be at opposite ends of a building;

b) fire-resistant walls shall be used to separate those areas in which stock is handled from offices, social rooms and technical facilities rooms; and

c) product-separating walls, fire-resistant walls or separating elements (depending on the risk) shall be used to separate filling rooms and commissioning areas for different product ranges.

11.1.3.4 The safety equipment and fire-protection measures necessary in the marshalling area are dependent on the degree of hazard presented by the products being handled. The quantity of such equipment permanently installed in the marshalling area should reflect the "worst-case scenario". The need to bring in additional equipment on a temporary basis for a particular operation should be minimized.

11.1.3.5 The marshalling area is the intermediate area between the loading zone and the stock warehouse; the flow of materials and personnel through the marshalling area shall be carefully regulated to avoid accidents. Non-company personnel, such as drivers who wish to load or unload, shall be required to report to a control point before being authorized to enter the marshalling area.

11.1.3.6 The size and construction of the marshalling area depends upon the type of warehousing operation. Where a large product range is stored and many small-volume shipments are made, the marshalling area is likely to be large in relation to the stock warehouse, particularly if the latter makes use of high-rack technology, and the construction of separate buildings is feasible. In the case of raw-materials warehouses, or warehouses that carry a small product range with large-quantity, large-volume stock movements, the marshalling area is likely to be small in relation to the size of the stock warehouse.

11.1.4 Boundary between the stock warehouse and the marshalling area

In a small warehouse that has only one fire section, the boundary between the stock warehouse and the marshalling area shall be permanently marked (for example, by paint lines on the floor and by a chain-link fence or by a light-duty partition of height about 2 m). In a larger warehouse with more than one fire section, the marshalling area shall constitute a separate fire section.

11.1.5 Loading zone

11.1.5.1 The loading zone borders the marshalling area direct. It encompasses waiting areas and parking spaces for commercial vehicles, and areas for the loading and unloading of containers. The design of the loading zone shall be such that inactive traffic is clearly separated from active traffic and loading work. When a ramp is provided for loading or unloading, economical space utilization is best achieved by loading or unloading at the rear of the vehicle; when loading or unloading is to be done at ground level, parallel parking and unloading from the sides of the vehicle are recommended.

11.1.5.2 The loading zone should provide space for the maximum number of vehicles that will be required to be loaded or unloaded simultaneously, and should take into account the types and dimensions of vehicles that are to be catered for.

NOTE Vehicles are likely to be up to 22 m in length.

11.1.5.3 Areas in the loading zone that are reserved for stacking pallets, or for waste skips, etc., should be clearly marked. Demarcated waiting areas should be provided for vehicles that cannot be processed immediately. Parking spaces at the ramp should be marked on the loading zone surface, as an aid to manoeuvring. If parking space at the ramp is to be provided for more than one vehicle, the marking should allow for an unobstructed walkway of width at least 1 m between vehicles when they are parked alongside each other, and for safe manoeuvring into and out of parking spaces. If a vehicle turning area is required, it should be of sufficient diameter to cater for vehicles of length up to 22 m. The entire loading zone should be marked appropriately.

11.1.5.4 Facilities shall be provided for the cleaning-up of accidental spillage or leakage in the loading zone, and operating procedures shall ensure that such cleaning-up is effected without delay. The loading zone shall not discharge direct to a drain or water course (see also 8.4.5).

11.1.5.5 When loading or unloading is to be done at the rear of a vehicle at ramp level after the vehicle has backed up to the ramp, the width of the loading zone, measured from the edge of the ramp to the edge of the road, should be at least 22 m. The width of the access road itself should be such as to permit vehicles to turn safely into it in one movement from the loading zone, and should in all cases be at least 6 m.

11.1.5.6 Vehicles can be parked for loading or unloading at an acute angle to the ramp; if this configuration is adopted, the width of the loading zone may be reduced accordingly, after taking into account the dimensions of vehicles to be catered for and the required manoeuvring room.

NOTE Vehicles are likely to be up to 22 m in length.

11.1.5.7 In the case of parallel parking at ground level, the width of the loading zone should be sufficient to allow operating space for fork-lift trucks on both sides of the vehicle, without encroaching on the road itself.

11.1.5.8 If a canopy is provided over the loading zone, consideration should be given to the useful height required. If the design requires that supports for the canopy be positioned in the loading zone, careful thought should be given to their position in relation to the anticipated positions of vehicles. Supports should be positioned about 12 m from the building when vehicles are likely to

park parallel to it and should have a protective "jacket" such as a concrete base of diameter approximately 1,2 m and height approximately 0,6 m (suggested dimensions).

11.1.5.9 Despite the provisions of 11.1.5.5 to 11.1.5.8 (inclusive), manoeuvring and turning areas provided for large vehicles should be of sufficient size that, during normal operations, vehicles are not required during manoeuvring and turning to encroach on through-roadways, whether these are external to the premises or form part of the site.

11.1.6 Boundary between the marshalling area and the loading zone

11.1.6.1 It is essential to prevent rainwater from the loading zone from entering the marshalling area, and to prevent firefighting water run-off from the marshalling area from reaching the loading zone.

11.1.6.2 Rainwater shall be prevented from entering the marshalling area by ensuring that, in the case of road vehicles

- a) a canopy is provided over vehicle docking areas,
- b) the vertical wall of the ramp is flush with the wall of the marshalling area,
- c) the surface of the loading zone has a gradient of about 2 % away from the building, so that water runs away from the building,
- d) a docking gate is provided, into which a delivery vehicle fits snugly, and
- e) a truck flap is provided at the outside top of the docking gate, to direct rain onto the roof of the vehicle.

These arrangements will assist in protecting products from the weather and from theft, and will improve cleanliness and working conditions in the marshalling area. In addition, accident hazards encountered by fork-lift trucks that operate on wet outdoor ramps will be eliminated.

The use of outdoor ramps is unavoidable when loading into or unloading from rail wagons. Outdoor ramps shall have a gradient (to lead water away from the building) of at least 1 % and should be covered with a canopy that extends at least 1,5 m past the outer edge of the ramp. The height of the canopy should be sufficient to prevent fouling against rail wagons, and the width of the outdoor ramp should be at least 4,5 m, to enable fork-lift trucks to operate. A gate should be provided in the wall of the marshalling area, through which fork-lift trucks can pass.

11.1.6.3 Firefighting water run-off from the marshalling area shall be prevented from reaching the loading zone. An internal ramp of maximum gradient 5 %, leading down towards a low-level floor in the marshalling area should be useful for this purpose.

11.2 Warehouse storage technology

11.2.1 General

11.2.1.1 The use of standardized storage units is essential if safe and economical storage is to be achieved.

11.2.1.2 The design of appropriate warehouse storage technology and, ultimately, of warehouse buildings, takes into account the dimensions (including tolerances) of the storage units to be used. For this reason, the variety of storage unit types and sizes shall be kept as small as possible.

11.2.1.3 The simplest storage unit is the storage container, which permits trouble-free handling and storage, owing to its set dimensions and design. The most frequently used storage unit, however, remains the wooden pallet.

11.2.1.4 The choice of the warehouse technology to be used in a hazardous-goods warehouse depends on logistical and economic criteria, in addition to safety requirements. The following warehouse storage technologies are used:

- a) block storage without racks;
- b) block storage with drive-in racks;
- c) block storage with through-racks;
- d) rack storage with movable racks;
- e) rack storage that uses normal fork-lift trucks;
- f) narrow-aisle rack storage;
- g) high-rack storage; and
- h) storage in packaging materials warehouses.

11.2.2 Block storage without racks

11.2.2.1 Using block storage without racks, storage units are stacked on the floor in double rows, and inspection corridors are kept free between each set of two rows. The inspection corridors provide limited access for product identification and leakage detection and also enable fire fighters to reach individual stacks. Traffic aisles are provided as necessary; a recommended configuration is one central aisle and subsidiary traffic aisles at right angles to it, separating blocks of stored product.

11.2.2.2 If block storage of this type is used, a space of at least 800 mm shall be left between stacks and exterior or partition walls, inspection corridors shall be of width at least 500 mm, and no row shall exceed 20 storage units in length. A maximum of three storage units may be stacked vertically; this provision may be relaxed when the height of the storage units is less than 1 m and the stack is robust.

11.2.2.3 Block rows, individual storage bays, traffic aisles, inspection and escape routes shall be marked out on the floor and numbered appropriately; these floor markings shall be permanent.

11.2.2.4 In the marking of adjacent rows, an allowance of 200 mm greater than the length of each storage unit shall be made, i.e. the maximum distance achievable between the two rows in a double row of storage units shall be 400 mm. In the marking of storage bays within a row, an allowance of 100 mm greater than the width of each storage unit shall be made, i.e. the maximum distance achievable between two storage units stacked side-by-side in a row shall be 200 mm.

11.2.2.5 Block storage of this type is of low cost in terms of equipment and infrastructure, but the storage height limitation is likely to have an adverse effect on the cost of the building.

11.2.2.6 It is difficult to detect leaks, disturbances to packaging, and fire in this type of storage configuration; the hazard is increased when storage units are stacked by means of a fork-lift truck.

11.2.2.7 Block storage of this type is suitable for small product ranges, where there are large quantities per product type and a large turnover volume. It requires that there be no necessity for

access to a specific storage unit; the general difficulty of access has negative implications for the safe storage of dangerous goods that present a fire or toxicity risk. Block storage without racks shall only be used for dangerous goods of SANS 10228, classes 8 and 9 and for aerosol dispensers.

11.2.3 Block storage with drive-in racks

11.2.3.1 Block storage with drive-in racks differs from that without racks in that the block rows consist of a permanent framework that has continuous supports for individual pallets or containers.

11.2.3.2 The centre-to-centre horizontal distance between two adjacent racks shall be approximately 1 550 mm. The rack width shall be such as to accommodate the storage units (i.e. normally 1 200 mm in the case of standard pallets) and the depth of each rack shall exceed that of the pallets or containers used by at least 50 mm.

11.2.3.3 One advantage of the drive-in rack design is that the height of storage is limited only by the lifting height of the fork-lift trucks used. Other advantages include

- a) reduced damage to storage units caused by stacking,
- b) reduced danger of product damage, leakage or spillage, and
- c) the ability to install fire alarms or firefighting facilities to allow in-rack sprinkling.

11.2.3.4 Block storage of this type presents a higher infrastructural cost than normal block storage, but this is compensated for by lower warehouse space demands.

11.2.3.5 Block storage with drive-in racks is recommended for products of all storage classes.

11.2.4 Block storage with through racks

11.2.4.1 The design of block storage with through racks is similar to that of the drive-in rack, but the solid supports are replaced with transporting mechanisms such as conveyor rails, sloping or motor-driven roller conveyors, chain drives or conveyor belts. Loading and removal of products can be carried out manually, or by fork-lift truck, or by means of automatic handling equipment.

11.2.4.2 This type of warehouse storage technology can be adapted to a wide variety of storage unit dimensions, and can therefore accommodate many types of small container, aerosol, cardboard box and pallet. It is logistically suited to the storage of a limited product range, with large quantities per product type and a very high turnover frequency. It requires that there be no necessity for access to a specific storage unit and, provided that appropriate safety facilities are installed, block storage with through racks is permitted for products of all storage classes. A maintenance aisle of width at least 500 mm shall be provided after every second line of racks, for maintenance and inspection purposes.

11.2.4.3 Block storage of this type has the highest capital installation costs per storage place, and for this reason is only used in practice for such applications as

- a) buffer storage immediately following a continuous filling or packaging line,
- b) buffer storage before high-speed commissioning, and
- c) buffer storage before shipping preparation.

11.2.5 Rack storage with movable racks

11.2.5.1 Rack storage with movable racks consists of racks on movable bases. The rack units are congregated to form blocks. Thus, only one or, at most, only a few aisles need to be kept open. The dimensions of the racks depend on the storage units used. Loading and removal can be carried out manually or by fork-lift truck, depending on the storage units. The useful height depends on the maximum lifting height of the fork-lift trucks.

11.2.5.2 The length of a movable rack unit shall not exceed 30 m. Transport and guide rails shall be laid with care, and shall lie flush with the surrounding floor surface. Special attention shall be paid to the reliability of mechanical and electrical safety features. Appropriate safety instructions relating to the use of movable racks shall be documented and adhered to.

11.2.5.3 Movable-rack technology offers the greatest volume utilization of available storage space, and is suitable for medium-sized product ranges, with a limited turnover frequency, and where access to each specific storage unit is necessary.

11.2.5.4 The high storage density achievable with this technology hinders the detection and fighting of fires. Fire alarms and firefighting facilities in large warehouses that use this technology shall be so installed as to allow in-rack fire detection and sprinkling of all storage positions. In addition, a fire-protection mechanism shall be provided that drives all movable racks apart by at least 500 mm in the event of a fire alarm or when activated manually, for example at the close of business each day. Provided that these safety features are built in, rack storage with movable racks can be permitted for products of all storage classes.

11.2.5.5 Capital costs for movable-rack technology are high, but can be offset by the high degree of space utilization achievable, especially when special climatic conditions such as product cooling or air conditioning are required.

11.2.6 Rack storage using normal fork-lift trucks

11.2.6.1 A rack storage system using normal fork-lift trucks consists of rows of racks separated by intermediate aisles. The dimensions of the rack spaces depend on the storage units used.

11.2.6.2 Rack lengths shall not exceed 50 m in cases where the rack is accessible from both sides, and 30 m where access is from one side.

11.2.6.3 The useful storage height is limited by the maximum lifting height of the normal fork-lift truck (for example a useful height of about 8 m is attained with a lifting height of 6 m). The required width of the aisles depends on the design of the fork-lift truck, and can vary between 2,8 m and about 4,2 m.

11.2.6.4 A rack storage system, using normal fork-lift trucks, is suited to the storage of large product ranges, with a moderate turnover frequency, in small to medium sized warehouses, where access to each individual storage unit is necessary. Rack storage using normal fork-lift trucks is permitted for products of all storage classes.

11.2.6.5 Fire detection and firefighting are simplified by the generous space arrangement necessitated by the use of fork-lift trucks. The attachment of racks to internal walls could present a potential hazard, since a fire in one section of a warehouse might break through to the next section. The use of separating elements, together with fusible bolts for attaching the racks, can greatly reduce this hazard.

11.2.6.6 Capital investment in racks and in normal fork-lift trucks is relatively low in view of their useful lifetimes; however, savings in this area could be offset by the cost of the required storage space.

11.2.7 Narrow-aisle rack storage

11.2.7.1 Narrow-aisle rack storage differs from rack storage using normal fork-lift trucks in that special fork-lift trucks that have swivelling forks, telescoping forks or a swivelling mast are used. The trucks are positively guided in the rack aisle, and the motions required to place products into storage or to remove them are carried out perpendicular to the axis of travel of the truck. The width of the aisle varies from 1,7 m to 1,9 m, depending on the dimensions of the storage units.

11.2.7.2 The useful storage height depends on the type of fork-lift truck used. With a modified normal fork-lift truck, a storage height of 8 m can be realized, whereas special trucks have been developed that have a maximum lifting height of 12 m, giving a useful storage height of approximately 14 m.

11.2.7.3 As some of the fork-lift trucks used in this type of storage are capable of operating automatically or semi-automatically, no person shall be allowed to enter the rack aisle during operations.

11.2.7.4 Narrow-aisle rack storage is suitable for large product ranges with a moderate turnover frequency, held in large warehouses, where access to each individual storage unit is necessary. Narrow-aisle rack storage is permitted for all product storage classes **except** those of SANS 10228, classes 1, 2 and 7.

11.2.7.5 The high capital costs of the racks and the specialized fork-lift trucks are generally offset by good utilization of the building volume.

11.2.8 High-rack storage

11.2.8.1 High-rack storage makes use of a fully automatic rack server that runs on guide rails. Lines of racks, which could be up to 150 m long and 45 m high, are located on both sides of the aisle along which the automatic rack server runs. The dimensions of the racks and rack spaces depend on the storage units, and are critical to the effective automatic running of the system. The aisle is normally only about 100 mm wider than the widest storage unit.

11.2.8.2 In the design of a high-rack storage system, the possible bending of a rack under load, the necessary precision required in the construction and the tolerances within which the guide rails are to be fitted shall be taken into account.

11.2.8.3 Contour sensors shall be used on high-rack systems, to check the storage units for allowable dimensions and to reject oversized or damaged storage units automatically.

11.2.8.4 No marking of rack spaces is required in this system, because stock management is computer-controlled.

11.2.8.5 High-rack storage technology is capable of a very high level of volume utilization. It is therefore suited to the storage of large product ranges, with a large turnover frequency, in large-capacity warehouses, where access to each individual storage unit is necessary. In relation to the volume stored, the floor space demanded is small.

11.2.8.6 High-rack storage is permitted for all products **except** those of SANS 10228, classes 1, 2, 3 and 7, provided that:

- a) automatic firefighting facilities are installed if flammable substances are to be stored; and
- b) the automatic rack servers are equipped with controls that "park" the system in the event of fire.

11.2.8.7 High-rack storage is a high-capital-cost solution to storage problems. Installation costs can partly be offset by the high level of volume utilization achievable and the low demand for floor space. This system is likely to be economical only when the warehouse turnover frequency is very high and the rest of the warehousing and marshalling operations are characterized by a high degree of order.

11.2.9 Storage in packaging materials warehouses

11.2.9.1 Packaging materials warehouses are used predominantly as an automatic packaging material buffer in advance of high-speed filling lines. Loading and removal are carried out automatically, using conveyors. Flows of material and stock management are performed by freely programmable controls or are controlled by microprocessors.

11.2.9.2 This type of storage is suited to small product ranges, where large quantities of each product type are turned over at a very high frequency. Typically, the warehouse capacity is very large, and there is no necessity for access to individual packaging materials.

11.2.9.3 Non-combustible metal packaging does not require any particular fire protection measures, but appropriate measures shall be taken where flammable packaging such as fibre drums or cardboard boxes are stored.

11.2.9.4 In terms of cost, the very high capital costs associated with packaging-materials warehouses are only compensated for by very high turnover frequencies coupled with large quantities.

11.3 Use of pallets

11.3.1 The storage of goods on pallets safeguards, to a certain extent, against the collapse of board cartons and contamination of products when liquid spills or flooding occurs. The variety of pallet sizes and types used in a warehouse shall be kept to a minimum.

11.3.2 Pallets shall be of sturdy construction. The condition of pallets shall be checked regularly and broken pallets shall not be used. Empty pallets shall be stacked neatly in areas reserved for this purpose.

11.3.3 Stacking patterns and maximum stacking heights on pallets shall be documented where appropriate, and shall be adhered to.

11.3.4 When goods are stacked on pallets, the horizontal dimensions of the product stack shall not exceed those of the pallet. Immediate attention shall be given to collapsing or collapsed loads on pallets, which shall be unpacked and re-stacked with care.

11.3.5 Allowance shall be made in the allocation of pallet storage space, for the possibility of gradual slipping, settling and leaning. Unsafe stacks shall be unstacked and unpacked as necessary and made safe by re-stacking or re-packing, as appropriate. Drums shall be stored upright on pallets.

11.3.6 When necessary, pallets shall be secured immediately after they are loaded, to aid the stability of the load. Securing of pallets shall be carried out in the marshalling area. The choice of a securing method shall take into account aspects such as the hazardous nature of the goods, the possible effects of weather and the risk of theft. When the nature of the goods permits, and pallets are to be secured by shrink packaging using an open flame, this operation shall take place in a separate room. After completion of the shrink-packaging process, a pallet shall be allowed to stand until it is certain that no fire hazard exists owing to smouldering. The most common pallet-securing methods are:

a) for sacks:

- 1) intermediate layers, with or without adhesive;
- 2) stretch packaging with plastics foil;
- 3) shrink packaging with plastics foil;
- 4) pallets with retaining bars;
- 5) cardboard retaining boxes; and
- 6) protective boxes;

b) for cardboard boxes and canisters:

- 1) stretch packaging with plastics foil;
- 2) shrink packaging with plastics foil;
- 3) metal retaining bands;
- 4) plastics retaining tapes; and
- 5) cardboard retaining boxes;

c) for round packages:

- 1) metal retaining bands;
- 2) plastics retaining tapes; and
- 3) stretch packaging with plastics foil.

11.4 Use of fork-lift trucks

11.4.1 General provisions

11.4.1.1 Fork-lift trucks and pallet trucks shall comply with the provisions of SANS 1726-1 and SANS 1726-2.

11.4.1.2 Fork-lift trucks shall travel with forks lowered, shall not carry passengers and shall not be left unattended with their engines running.

11.4.1.3 Fork-lift trucks shall be kept outside the warehouse when not in use, and shall only be permitted inside the warehouse when normal operating conditions prevail. Under no circumstances shall fork-lift trucks be used when an explosive atmosphere is thought to have arisen, when ventilation is inadequate, or when their use is likely to exacerbate a hazardous abnormal situation.

CAUTION — Fork-lift trucks driven by petrol or liquefied petroleum gas (LPG) shall not be used in formulation plant areas where substances of class 1, division 2.1 and classes 3 and 4 are processed (see 4.2).

11.4.1.4 Fork-lift trucks shall be operated in accordance with the relevant operating procedure(s).

11.4.1.5 The safe permissible working load shall be marked on each fork-lift truck, and shall not be exceeded.

11.4.1.6 Fork-lift trucks shall be maintained in good working order and examined and tested regularly, and full records shall be kept of all tests.

11.4.1.7 Fork-lift trucks shall not be used for purposes other than vertical lifting or for purposes for which they are not designed (for example, they shall not be used to drag loads across a floor).

11.4.1.8 Adequate turning and manoeuvring space shall be provided in all areas in which fork-lift trucks are to be used.

11.4.1.9 A fork-lift truck with a capacity of 750 kg or more shall only be operated by an operator in possession of a certificate issued by an organization approved for this purpose by the relevant national authority (see foreword).

11.4.1.10 A carbon dioxide type fire extinguisher in compliance with SANS 1567, or a dry chemical type fire extinguisher in compliance with SANS 1910 shall be fitted onto each fork-lift truck.

11.4.2 Compression ignition (diesel) engines

Fork-lift trucks powered by compression ignition (diesel) engines may be used in an enclosed warehouse or a covered outdoor storage area, provided that

- a) they are not fitted with electric batteries, generators or other electrical equipment, unless such equipment is designated flameproof or intrinsically safe,
- b) electrical equipment is earthed effectively and bonded to the engine frame,
- c) engine starting is preferably by hand-cranking, by inertia, or by means of a compressed-air starter; if an electric starter is used, the engine shall be started by an auxiliary battery system sited in a safe area, the connection being made through a heavy-duty plug and socket,
- d) cooling fan blades are of a non-metallic material,
- e) drive belts are of an anti-static type,
- f) they are fitted with an approved flame trap (for example a spaced plate-type), on the air intake down-stream of the air cleaner,
- g) they are fitted with a cut-out device, operable from the driving position, that will stop the engine when ingestion of flammable gas or vapour might cause overspeeding, and
- h) the exhaust outlet is fitted with a spark arrestor (preferably of the cyclone type) and a flame trap down-stream of the spark arrestor.

NOTE A combined flame trap and spark arrestor may be used.

11.4.3 Battery-powered electric motors

Battery-powered fork-lift trucks may be used, provided that they have been fitted with electrical components that carry flame-proofing certificates and that the vehicle itself is designated "flame protected".

11.4.4 Spark ignition (petrol-driven and LPG-driven) engines

CAUTION — Fork-lift trucks driven by petrol engines or by LPG engines shall not be used in enclosed warehouse areas where dangerous goods are stored, loaded or unloaded.

Fork-lift trucks driven by petrol engines or by LPG engines may be used in outside (open) storage areas, provided that

- a) the exhaust pipe is fitted with an efficient flame trap,
- b) filling of the fuel tank and engine starting are carried out in a safe area,
- c) the battery is enclosed in a protective metal box with an insulated cover, to minimize damage and to prevent short-circuiting (and therefore sparking) in the event of a metal object falling on it, and
- d) drivers are supervised and trained to switch off engines immediately if any product spillage or other source of flammable vapour occurs.

11.5 Product-specific technology

11.5.1 Product cooling

Product cooling shall be achieved either by using refrigerated chests or by cooling the entire room, as appropriate in the circumstances. Cooling facilities shall be monitored to ensure that the maximum permissible temperature is not exceeded.

11.5.2 Product heating

11.5.2.1 Certain liquid products have to be heated to maintain a low viscosity or to prevent crystallization. Containers or piping systems may be warmed by means of double-jacket heaters, circulating steam or warm water, or by electrical heaters. Products that require to be heated shall be stored and heated in a room separate from other storage areas.

11.5.2.2 The compatibility of the products with the double-jacket heating medium (steam, warm water or oil) shall be tested before such heating is carried out. Heating chambers shall be used as necessary for packaged goods. Appropriate monitoring shall ensure that heating media are maintained within their specified temperature ranges.

11.5.2.3 Electrical heaters shall be protected in accordance with SANS 10108, and shall be equipped with temperature-limiting circuits.

NOTE Explosion-protected equipment is likely to be required for product heating of flammable liquids to temperatures above their flash points.

11.5.3 Product transfer equipment

Facilities used for the conveyance of loose goods, such as

- a) pumps for the transfer of liquids,
- b) blowers for the pneumatic transfer of powders, and
- c) conveyors for solids,

shall, in the event of an emergency, be capable of being switched off quickly from a safe location.

12 Safe operating practice and good housekeeping

12.1 General

CAUTION — It is essential that, in any given emergency situation, the available safety facilities and protective clothing are correct and appropriate for the risks to be encountered. It is not sufficient merely to provide a selection of equipment. All persons likely to be involved in using safety facilities or wearing protective clothing shall be appropriately trained (see 14.6), and the training shall be regularly updated, to ensure that the correct safety facilities and protective clothing are correctly used in an emergency.

12.2 Equipment and compliance

12.2.1 Equipment

12.2.1.1 Equipment, including machinery and vehicles, used in a warehouse shall comply with the requirements of all regulations relating to the class(es) of goods held in the warehouse. In particular, and where applicable, equipment shall be such as to comply with the national regulations and statutory provisions for personal safety equipment and facilities (see 9.8 and foreword).

12.2.1.2 Before a warehouse is brought into use, the warehouse controller shall ensure that appropriate personal protective equipment, breathing apparatus, equipment for spillage collection and disposal, first-aid equipment, firefighting equipment, internal and external safety signs, safety showers, and fire alarm and detection equipment are in place and in serviceable condition, and that they are so kept as to avoid possible contamination.

NOTE Extreme care and forethought are required in deciding upon the locations for such equipment; for example, breathing apparatus and personal protective equipment need to remain safely accessible, irrespective of the direction of the spread of a fire or of toxic fumes, and a safety shower might be required outside the premises to enable firefighters to obtain immediate relief from possible body contamination by toxic chemicals.

12.2.1.3 All safety-related equipment, apparatus, etc., shall be checked regularly, in accordance with clause 19, and the results documented (see also annex D).

12.2.2 Compliance

When a dangerous substance is being handled, the instructions on the SDS or the label (as applicable) shall be followed, taking cognizance of all special precautions concerning protective clothing and equipment, irrespective of occasional handling or intensive handling, and irrespective of the quantity of substance used.

12.3 Personal protective clothing and equipment

12.3.1 General

12.3.1.1 The warehouse controller shall ensure the proper usage, maintenance and storage of personal protective clothing. Operating procedures shall ensure that workers wear the prescribed clothing, and in particular that they do not enter areas where toxic products are stored, or in which there has been a spill or leak, without the appropriate protective clothing. Used, discarded or contaminated protective clothing shall be treated in an appropriate manner, which shall be documented in operating procedures.

12.3.1.2 When a dangerous substance is being handled, the instructions on the SDS or the label (as applicable) shall be followed, taking cognizance of all special precautions concerning protective clothing and equipment, irrespective of occasional handling or intensive handling, and irrespective of the quantity of dangerous substance used.

12.3.1.3 All operators shall clearly understand that, even though protective clothing and equipment are used, great care shall still be taken.

12.3.1.4 All protective clothing and equipment shall be collected at the end of each day or at the end of each operation, as applicable. No used protective clothing or equipment shall be worn unless it has been thoroughly washed or decontaminated.

12.3.1.5 An employer shall ensure that no worker removes dirty or contaminated clothing or equipment from the premises. Dirty or contaminated clothing or equipment to be disposed of, or washed, or decontaminated outside the premises, shall be treated as hazardous chemical goods in accordance with the relevant national regulations and statutory provisions, and any provincial or local regulatory requirements.

12.3.1.6 Two lockers, one marked "Protective clothing" and the other one marked "Personal clothing", shall be available to ensure that clothing is kept separate.

12.3.1.7 Separate "clean" and "dirty" change rooms shall be available if dangerous substances are used to such an extent that they could endanger the health of persons outside the workplace.

12.3.2 Overalls

12.3.2.1 An overall provides good body protection for an operator working with dangerous substances. A loose-fitting two-piece garment (separate top and trousers) provides flexibility in that the top and trousers can be worn separately or together over normal work clothes.

12.3.2.2 Cotton is one of the most effective, durable and comfortable materials for an overall. A cotton overall shall be made of 100 % cotton with a mass per area of 110 g/m² and should preferably have elasticized cuffs and no pockets. Alternatively, an overall can be made of lightweight synthetic material specifically developed for the protection of operators working with dangerous substances.

12.3.2.3 An overall shall

- a) be impervious to products stored,
- b) be durable,
- c) give splash and droplet protection,
- d) be comfortable,
- e) be light in weight, and
- f) be light in colour so as to permit visual identification of contamination.

12.3.3 Protective aprons

12.3.3.1 A protective apron gives additional protection against spills and splashes of dangerous substances. A protective apron shall be made of impervious non-woven material. It shall cover the front of the body from the top of the chest to below the knees and shall also wrap round the sides of the body and legs. A light colour, which allows for visual identification of contamination, is preferable. Disposable aprons can be used as an alternative.

12.3.3.2 An apron shall be

- a) impervious to substances handled,
- b) durable,
- c) comfortable, and
- d) affordable.

12.3.4 Eye and face protection

WARNING – A face shield shall not be worn during the application of dangerous substances that emit toxic vapours or low boiling-point organic solutions.

12.3.4.1 A face shield made of clear transparent material is a comfortable form of eye and face protection. A face shield offers protection against splashes and is less likely to mist over than goggles. If eye protection is needed, and a face shield is not available, a pair of safety goggles is an acceptable alternative. The material of the shield shall be impervious to a wide range of dangerous substances.

12.3.4.2 The head band of the face shield shall be made of solvent-resistant foam plastic. The foam plastic shall not absorb spray droplets and shall be non-irritant to the skin.

12.3.4.3 The face shield shall be of height approximately 150 mm and of width approximately 300 mm in order to give full face protection. The top of the face shield shall be curved or shall be flexible to fit the face and shall be of sufficient width to keep the shield clear of the face. The shield shall be held against the head by an adjustable strap.

12.3.4.4 A face shield shall be

- a) transparent,
- b) impervious to solvents,
- c) non-misting,
- d) durable,
- e) light in weight, and
- f) non-reflective.

12.3.5 Gloves

CAUTION – Immediately after use and before being removed from the hands, the gloves shall be washed with soap and water. Contaminated gloves shall not be touched with bare hands when being removed. The gloves shall be turned inside out and shall be washed again, and rinsed and allowed to dry completely before being put away.

12.3.5.1 Protective gloves are available in a variety of materials and designs. Gloves shall fit the hands comfortably and shall be flexible enough to grip an object firmly. Gloves shall be long enough to cover a minimum of 90 mm above the wrist. Gloves made of nitrile rubber offer good protection against a wide range of dangerous substances and shall be of light colour so as to permit visual identification of contamination. PVC, neoprene and butyl rubber are suitable alternative materials. Lined gloves are not recommended, since contaminants can accumulate in the lining material.

12.3.5.2 Disposable polyethylene gloves or plastics bags may be used as temporary hand protection, but shall be used for **one operation only**, and shall then be discarded.

12.3.5.3 Gloves shall be

- a) durable, and
- b) non-slippery.

NOTE Compatibility of gloves and substance to be handled should be checked as part of the selection process.

12.3.6 Boots

12.3.6.1 Rubber boots give protection against the widest range of liquid dangerous substances, whereas steel toecaps leather footwear is suitable for protection against falling objects.

12.3.6.2 The rubber boots shall be at least calf-high and shall be unlined. Trousers shall be worn outside the boots to prevent any spills or splashes from entering the boots. To prevent injury when large steel drums are being handled, boots with steel toecaps shall be worn.

12.3.7 Head coverings

A hood (with a built-in respirator) to cover head, neck and shoulders for total skin protection shall be worn during the handling or decanting of irritant powders or substances emitting toxic vapours.

12.3.8 Respirators

Respirators shall comply with the requirements of SANS 10220.

12.4 Washing facilities

12.4.1 Soap, clean towels and clean water shall be available near the operation area, but shall be so located as to avoid contamination by dangerous substances. When contamination has taken place, a safety shower (which could consist of an elevated punctured water container) shall be within easy reach. There shall be no interchange of towels, soap or water between operators. Compressed air shall not be used to remove dust from the body.

12.4.2 Where possible, running water shall be used for washing. When running water is not available, each operator shall be provided with separate, clearly marked containers for washing of the body and of protective clothing and equipment.

12.4.3 Each operator shall wash or shower at the end of each operation or shift.

12.4.4 Contaminated washing water shall not be disposed of into ANY water source, including rivers, ground water sources and sewerage systems.

12.5 Safety Data Sheets (SDS)

12.5.1 A full set of up-to-date Safety Data Sheets for all dangerous goods stored in a warehouse shall be available at least at one central location, which may be an administration office or a security office. Key employees who are likely to become involved in the control of an emergency situation shall be aware of the location of, and have access to, the data sheets.

12.5.2 A further identical set of Safety Data Sheets shall be lodged with the local fire authority as part of the emergency plan.

12.5.3 Individual Safety Data Sheets shall be made available to all employees who are likely to come into contact with particular products. Before starting work in areas where the products are stored, such employees shall have received training in the contents of the Safety Data Sheets.

12.5.4 The appropriate individual Safety Data Sheet shall be posted in a prominent position in the area where each product is stored.

12.5.5 Every manufacturer, importer or distributor of dangerous goods intended for use in the workplace shall, as far as practicable provide Safety Data Sheets to the party receiving such dangerous goods, free of charge.

12.5.6 The Safety Data Sheet shall contain the information set out in SANS 11014 (see also foreword). Any new information on dangerous goods that becomes available to the supplier, manufacturer, importer or distributor shall be forwarded to the recipient of the Safety Data Sheets free of charge. A system shall be established to ensure and record the issue of, and the proper updating or replacement of, obsolete Safety Data Sheets.

12.6 Product information file

12.6.1 A product information file that covers all the dangerous goods stored in the warehouse shall be available at, at least one central location, which may be an administration office or a security office. Key employees who are likely to become involved in the control of an emergency situation shall be aware of the location of, and have access to, the product information file. At the discretion of the warehouse controller, a copy of the product information file may form part of the emergency plan.

12.6.2 The product information file shall contain, for each product, data additional to that contained in the Safety Data Sheets, and that are relevant to the safe warehousing of the product. Examples of such data might include

- a) product identification (for example name, formulation, and UN No.),
- b) physical state,
- c) product-specific requirements for storage,
- d) product-specific requirements for transportation,
- e) a cross-reference to the corresponding Materials Safety Data Sheet,
- f) the type(s), masses and volumes, of packages stocked, and
- g) appropriate rules for storage on pallets, securing of pallets and stacking.

12.7 Stock list

Accurate records of stock holdings shall be maintained at all times. Items in stock shall be recorded in a stock list (which may be held on computer media) that contains at least the following information:

- a) product identification (for example name, formulation and UN No.);
- b) SANS 10228 classification;
- c) lot or batch number;
- d) date of receipt;
- e) quantity in stock (subdivided as appropriate, for example into total quantity, available quantity, quantity not available owing to quarantine and customs bonding);
- f) packaging type(s) and quantity held of each type;
- g) number of storage units and type (for example 800 mm × 1 200 mm pallets and number of 1 200 mm × 1 200 mm × 1 100 mm tank containers); and
- h) storage place (number of warehouse, subsection or storage bay).

12.8 Separation and segregation

12.8.1 General

12.8.1.1 The primary purposes of product segregation (see 3.14) and separation (see 3.16) are

- a) to minimize the risk to people, property and the environment owing to fire and its aftermath, for example risk due to contamination of run-off water and high-temperature reactions between toxic products,
- b) to minimize financial risk in the event of a fire or an explosion, by containment of the problem, and
- c) to simplify the logistical and financial problems associated with the storage of different classes of product, for example by minimizing the number and size of fire zones, by minimizing bunding and spillage containment requirements, and by minimizing the number of locations in which it is necessary to install protected electrical equipment.

12.8.1.2 The following general principles are to be applied in product separation and segregation:

- a) product separation and segregation shall be based on a detailed knowledge of the properties of, and hazards associated with, the dangerous goods to be stored. SANS 10228, SANS 10234 and Safety Data Sheets are of vital importance in this regard; and
- b) product separation shall be based on firefighting needs, for example products for which a dry firefighting medium is required shall, in general, be stored separate from products for which water or foam is required. Where the use of water is desirable for cooling items such as gas cylinders, and the water itself is unlikely to become contaminated, it is essential that such storage areas be separate from areas in which the use of water would create additional hazards. Ongoing liaison between the warehouse controller and the local fire authority is essential.

12.8.1.3 A licence is required for the supply of, or keeping for supply of, certain dangerous substances (see foreword). The licensee shall keep all such dangerous substances separate in a securely locked store.

12.8.1.4 The separation and segregation of dangerous goods in storage shall be based on the hazard class as indicated by labelling in accordance with SANS 10229-1, SANS 10229-2, SANS 10233 or SANS 10234, as applicable. The compatibility table E.1, gives information on the compatibility of classes of dangerous goods.

12.8.1.5 Incompatible dangerous goods shall be segregated from one another so as to effectively minimize risk in the event of accidental leakage or spillage or any other accident (see also 14.6.1(d)).

12.8.1.6 Whenever dangerous goods are stored together, the most stringent segregation provisions for any of the goods shall apply.

12.8.1.7 In the case of a substance that has two or more hazards, the most stringent segregation provisions for any of the goods shall apply.

12.8.1.8 Packaging of dangerous goods shall be located within a warehouse in a way that minimizes the likelihood of dangerous interaction. Without limiting this, dangerous goods shall be segregated from incompatible substances, substances with which they may react violently and any other dangerous goods in accordance with the following requirements:

a) where the substances are incompatible they shall be

- 1) kept in separate areas, or
- 2) segregated by a distance of at least 3 m, except that, when both substances are solids, the distance may be reduced to 1 m; and
- 3) where incompatible substances that react violently are stored they shall be segregated by at least 5 m, and not share a common drainage system; and

b) dangerous goods that are required to be stored in separate areas shall be prevented from falling, leaking or spilling into another area.

12.8.1.9 Separation distances shall be measured in a horizontal plane in the case of

a) **liquids**, from the top inside perimeter of the bund wall, or

b) **solids**, from the nearest package.

12.8.1.10 Separation distances could be measured around an intervening screen wall, provided that

a) the wall extends at least 1 m above the highest container in the warehouse, and

b) the wall is marked to indicate the maximum storage height.

12.8.2 Compatibility and special provisions for all classes of dangerous goods

12.8.2.1 In addition to the requirements given in 12.8.3 to 12.8.10 for segregation and separation of dangerous goods, the following shall be consulted:

- a) the compatibility chart, table E.1; and
- b) the special provisions applicable to all classes of dangerous goods (see E.2).

12.8.2.2 Explosives shall be stored together in accordance with the relevant local legislation and regulations (see foreword).

12.8.3 Segregation of dangerous goods from foodstuffs

Foodstuffs, products for human or animal consumption, empty foodstuff containers, materials for the production of foodstuff packagings, and medical and veterinary material may be kept in the same warehouse as dangerous goods of categories 2 and 3 provided that

- a) they are kept at least 5 m from dangerous goods,
- b) they are not kept in the same area as dangerous goods, unless the dangerous goods are kept on pallets, shelves or a racking system,
- c) dangerous goods are not stored above the foodstuffs. In the event of foodstuffs being stored above dangerous goods, the segregation distance shall be measured in a vertical plane from the top of the dangerous goods packaging to the bottom of the foodstuffs packaging,
- d) the foodstuffs and dangerous goods packaging have not been opened, and
- e) a risk assessment shall be carried out to determine the potential hazards in case of spills, fire or any incident that would cause contamination.

12.8.4 Separation of dangerous goods from combustible materials

12.8.4.1 Dangerous goods shall be separated from accumulation of combustible materials that, if involved in a fire, are likely to present a significant heat radiation hazard to the mixed class dangerous goods warehouse.

12.8.4.2 Combustible materials are those materials that do not fall readily into one of categories 1 to 3, but that will burn, albeit less vigorously than flammables, in the event of a fire. Many items of packaging are combustible. In general, combustible materials constitute low fire risk and reactivity hazards. Non-dangerous combustible materials should therefore be used to enhance segregation, by providing a low-risk barrier between other groups or classes of product that are required to be segregated in terms of the provisions listed above.

12.8.5 Storage of flammable liquids of class 3, toxic substances of division 6.1 and corrosives of class 8

12.8.5.1 Nitro-methane class 3, UN No. 1261, shall be separated from substances of class 6.1, and cyanides of division 6.1 shall be separated from acids of class 8.

12.8.5.2 Concentrated acids and bases shall be segregated by at least 1 m.

12.8.6 Storage of oxidizing substances of division 5.1

The storage of oxidizing substances of division 5.1 shall comply with the provisions of SANS 10263-5.

12.8.7 Storage of non-dangerous goods in segregation spaces

It is permissible to store non-dangerous goods in segregation spaces, provided that

- a) they are non-combustible and will not react dangerously with the other dangerous goods in storage,
- b) a hazard assessment, including an assessment of additional fire load, has been carried out, and
- c) any necessary additional fire protection is provided.

12.8.8 Storage of all classes of dangerous goods, except radioactive material

12.8.8.1 Flammable materials (see division 2.1, and classes 3 and 4 in SANS 10228) will greatly increase the risk of a toxicant fire if stored in the same area as toxicants, therefore:

- a) Flammable non-toxic materials shall be **separated** from flammable toxicants and from aerosols.
- b) Flammable toxicants shall be **separated** from non-flammable toxicants.
- c) Flammable materials shall be **segregated** from oxidizing substances and corrosives.

12.8.8.2 Oxidizing substances and organic peroxides (see class 5 in SANS 10228) can react violently with other products, and in particular with reducing substances and certain organic substances.

Oxidizing substances and organic peroxides shall be **segregated** from reducing substances, toxic substances and infectious substances, and from aerosol dispensers, flammables and corrosives.

12.8.8.3 Toxic and infectious substances (see class 6 in SANS 10228) can contaminate firefighting water in the event of a fire, therefore:

- a) Toxic and infectious substances shall be **separated** from other flammable products and aerosols.
- b) Toxic and infectious substances shall be **segregated** from oxidizing substances, organic peroxides and corrosives.
- c) Flammable toxic and infectious substances shall be **separated** from non-flammable toxic and infectious substances (see 12.8.8.1).

12.8.8.4 Corrosives (see class 8 in SANS 10228) that leak or spill from their packaging can cause serious damage to other packages, with potentially hazardous consequences.

Corrosives shall be **segregated** from toxic substances, infectious substances, aerosols, flammables, oxidizing substances and organic peroxides.

12.8.8.5 Miscellaneous dangerous substances and goods (see class 9 in SANS 10228) could require special storage arrangements. Safety Data Sheets shall be consulted, and, if necessary, further advice and information shall be obtained from the suppliers.

12.8.9 Storage of aerosol dispensers

12.8.9.1 Aerosol dispensers can explode in a fire, thereby increasing the danger to fire fighters and increasing the risk of the fire spreading.

12.8.9.2 Aerosol dispensers shall be **separated** from toxic substances, infectious substances and flammables.

12.8.9.3 Aerosol dispensers shall be **segregated** from oxidizing substances, organic peroxides and corrosives (see also 12.8.8.2).

NOTE See 11.2.2.7 for the warehouse technology applicable to aerosol dispensers.

12.8.10 Storage of radioactive material

12.8.10.1 Radioactive material of class 7 is subject to separate legislation and control. The storage of such radioactive material shall be in accordance with relevant legislation and regulations (see foreword), in terms of which the authorities described in 12.8.10.2 to 12.8.10.4 shall be consulted for specific information.

12.8.10.2 The national authority for nuclear safety has the responsibility to provide for the protection of persons, property and the environment against nuclear damage through the establishment of safety standards and regulatory practises, and to exercise regulatory control related to safety, by granting authorization for

- a) siting, design, construction, operation, decommissioning and closure of nuclear installations, and
- b) other actions to which the relevant legislation and regulations apply, including transport of radioactive material in terms of the International Atomic Energy Agency (IAEA), *Regulations for the safe transport of radioactive material* (see also SANS 10229-1).

12.8.10.3 The national health authority has the power to grant written approval for

- a) the production, acquisition, disposal, possession, use and conveyance of certain radioactive substances, and
- b) the importation and exportation of any of the said radioactive substances.

NOTE In South Africa a radioactive substance regulated by the national health authority is defined as a group IV hazardous substance outside a nuclear installation that does not form part of, nor is intended to be used, in the nuclear cycle, and that has

- a) an activity concentration exceeding 100 Bq/g and a total activity exceeding 4 kBq, or
- b) an activity concentration not exceeding 100 Bq/g and a total activity not exceeding 4 kBq, and is used, or is intended to be used for medical, scientific, agricultural, commercial or industrial purposes, and also radioactive waste arising from such radioactive material.

12.8.10.4 The national nuclear energy authority has the power to

- a) acquire, possess, use, dispose of, import and export source material and special nuclear material, and
- b) transport source material, special nuclear material, nuclear fuel, irradiated nuclear fuel, radioactive material and radioactive waste.

12.9 Storage plan

12.9.1 A storage plan shall be prepared for each stock warehouse. The storage plan shall be updated at least once a year, but shall also be updated in the event of changes such as in product line, building layout or operational procedure. The plan shall, as far as possible, incorporate anticipated seasonal variations in stock levels. A system shall be implemented to ensure that obsolete storage plans are replaced by current plans. A copy of the current storage plan shall be displayed in a convenient central location, and it shall be brought to the attention of all employees. In addition, the storage plan shall be part of the emergency plan (see clause 16), and shall be distributed accordingly.

12.9.2 If a site contains several stock warehouses, each shall be given a different number. Within each stock warehouse, each separate storage area shall be numbered and each individual storage bay shall be uniquely numbered, so that no two storage bays on the same site bear the same number, even if the bays are in different buildings. An appropriate variation of a three-dimensional (x,y,z) co-ordinate system is recommended for numbering.

12.9.3 The storage plan for each stock warehouse shall show

- a) the warehouse number,
- b) the subsection number for each separated area,
- c) the nature and hazard of the main product groups in each subsection, differentiated, where necessary, by the storage bay number,
- d) the fire zones (which may or may not be the same as the fire sections, see 8.1.2 and 10.1.2),
- e) the maximum allowable quantities per fire section and subsection, and
- f) the locations of all firefighting facilities and emergency exits.

12.10 Stock rotation

Proper rotation of stock shall be carried out to prevent accumulation of old stock and possible deterioration of both product and packaging. Goods whose efficacy or saleability is in doubt, or whose shelf life has expired, shall be set aside and either returned to the supplier or disposed of safely in an appropriate manner (see clause 18). Where regulations lay down specific disposal requirements for goods, they shall be followed. If any doubt exists as to the correct procedure for the disposal of dangerous goods, the assistance and advice of suppliers, or of waste disposal specialists (or both) shall be obtained before the goods are disposed of.

12.11 Checking of labelling

Containers shall be checked regularly to ensure that they are properly labelled. If a label is lost or becomes illegible and the identification of the product is known, the container shall be relabelled immediately, in letters of height at least 25 mm, with the product name, a cautionary notice and the words "NOT TO BE SOLD", and the supplier shall then be consulted for further instructions. If the identification of an unlabelled product is not known, the container shall be labelled, in letters of height at least 25 mm, with the words "DANGEROUS GOODS – CONTENTS UNKNOWN", and the possible suppliers shall then be consulted for further identification and assistance.

12.12 Inspection for damage and leakage

All stock shall be inspected regularly for damage to packaging or signs of leakage or spillage. Any leaks or spills shall be cleaned up immediately in the appropriate manner (see 12.13). Products stored in outdoor bunded areas shall be checked frequently for leakage, in order to prevent contamination of the drainage system.

12.13 Dealing with leakage or spillage

12.13.1 General

12.13.1.1 Care shall be taken to prevent leakage or spillage of dangerous goods. Action shall be initiated immediately to clean up leaks or spills.

12.13.1.2 Product salvaged from spillage or leakage shall not be sold or used unless the original supplier and the potential customer or user accept the degree of contamination that might have occurred.

12.13.1.3 Employees who become seriously contaminated with toxic or infectious products shall immediately be removed from areas of contact with the product, and medical advice shall be sought.

12.13.1.4 When an employee has been, or is suspected to have been, contaminated with a dangerous substance and is required, on medical advice or in terms of regulations, to undergo testing for the level of that substance in his body, the warehouse controller shall ensure that such testing is carried out, that the results are recorded, and that all other statutory regulations in this regard are complied with (see foreword).

12.13.2 Hazards

Personnel shall be made aware that they could be subjected to the following hazards that can arise during the cleaning up of leaks or spills:

- a) breathing in of fine dusts or vapours from volatile products;
- b) splashing, especially when decanting from damaged containers;
- c) deposition and possible absorption by direct skin or eye contact, either from bulk material or its airborne dust, and possible subsequent transfer to the mouth; and
- d) fire or explosion hazard.

12.13.3 Equipment and chemicals

In addition to the personal protective clothing referred to in 12.3, and depending on the nature of the dangerous goods stored, some or all of the equipment and chemicals listed below might be appropriate for cleaning up leaks and spills; equipment and chemicals kept for this purpose shall be kept in the warehouse building and shall be readily available at all times:

- a) empty, unlabelled packages and drums, which bear the following marking in letters of height at least 25 mm: "WASTE DRUM FOR EMERGENCY USE ONLY";
- b) yard broom(s) and shovel(s);
- c) decanting valves;
- d) funnel(s);

e) sand or dry earth, in buckets;

f) hydrated lime;

NOTE Lime is the preferred absorbent for most pesticides (see SANS 10206). Sawdust is a fire hazard and is unsuitable for use with dangerous goods.

g) soda ash; and

NOTE Soda ash is preferred to lime for use in acid spills.

h) liquid industrial detergent.

12.13.4 Action to be taken in the event of a leak or spill

12.13.4.1 The area in which leakage or spillage is detected shall immediately be isolated to prevent people from inadvertently walking through concentrated product (see also 8.4).

12.13.4.2 An attempt shall be made to identify the product, and to determine, from the label, Safety Data Sheet, storage plan or other source, the recommended protective clothing to be worn and the best method of cleaning up the leak or spill. If the required information is not immediately available, full protective clothing shall be worn (see also 12.6).

NOTE Regular and appropriate emergency response training of all personnel working with dangerous substances in storage areas, will help to minimize the effects of any incident or spill.

12.13.4.3 If there is any doubt about breathing hazards, a respirator or, especially in the case of a large liquid spill in a confined space, self-contained breathing apparatus shall be worn.

12.13.4.4 If in doubt about any aspect of dealing with a leak or spill, the supplier and appropriate authority shall be consulted for advice.

12.13.4.5 It is important to keep the volume of liquid to a minimum to simplify safe disposal of the waste. Liquids shall be prevented from entering any drains, water courses or the like, directly.

12.13.4.6 Equipment used in the clean-up and all clothing shall be decontaminated. Where necessary, personnel who were directly involved in the clean-up shall take a shower in their protective clothing before removing it.

12.13.4.7 Waste receptacles shall be labelled appropriately.

12.13.4.8 Spilled dangerous goods and leaking or broken containers shall be removed immediately to a safe area to await disposal in conformance with applicable regulations and manufacturer's instructions. Spilled material shall be placed in a clean separate container that is sift proof for solids and leak proof for liquids, and shall not be returned to the original container. The waste of dangerous goods shall not be combined with that of ordinary trash and the disposal shall be carried out by a person or persons trained in accordance with 14.6.

12.13.5 Leakage and spillage of liquids

12.13.5.1 In addition to the requirements of 12.13.4.8, leaking containers shall be removed to a location set aside for the purpose and shall, if possible, be so positioned that they stop leaking. Overpacks shall be provided for drums, and shall be used when necessary to minimize spillage and to facilitate movement of leaking drums. Small containers shall be placed upright in a plastics bag.

CAUTION — Ensure that the liquid from the container will not react with the plastics bag.

12.13.5.2 If the leakage requires that the container be emptied immediately, this shall be done by decanting (see 12.13.7) the contents into a clean container, if possible by using a decanting tap. New containers shall be properly labelled (see 12.11).

12.13.5.3 Spilled materials shall be absorbed in an appropriate medium (sand, dry earth or hydrated lime, **but not sawdust**) and then placed in a waste drum for disposal. The residue shall be removed by damping down the contaminated area with water, absorbing as before, and adding to the waste drum.

CAUTION — Water shall only be used where it will not react with the materials in a hazardous manner.

12.13.5.4 Containers that have been contaminated with spilled liquid shall be rinsed with water until free from visible contamination; wash water shall be added to the waste drum (see also CAUTION in 12.13.5.3).

12.13.5.5 The contents of the waste drum shall be disposed of in accordance with clause 18.

12.13.6 Spillage of solids

Small to moderate quantities of spilled material shall preferably be collected by means of a vacuum cleaner reserved for this purpose. Where a large quantity of material, especially toxic material, has been spilt, the area shall first be covered with sand, and the spilled material or sand mixture shall be collected in appropriate receptacles for disposal. Remnants shall be collected by means of a vacuum cleaner. If a vacuum cleaner is not available, the material shall be carefully swept up with a brush or broom, the evolution of dust being avoided. The collected material shall then be placed in a waste drum for disposal.

The area of the spillage shall then be wetted with a small amount of water, and the water shall be absorbed in an appropriate medium, which shall then be placed in the waste drum (see the CAUTION in 12.13.5.3). The contents of the waste drum shall, if appropriate, be wetted to prevent dust evolution, and shall then be disposed of (see clause 18).

12.13.7 Decanting

Containers shall not be opened and materials shall not be decanted, weighed or otherwise transferred from one receptacle to another in the storage area. If such operations are necessary, they shall be conducted in a special area reserved for this purpose, and appropriate operating procedures shall be in place and shall be followed.

12.13.8 Construction and maintenance work

12.13.8.1 All persons who carry out construction or maintenance work on, in or adjacent to buildings or areas in which dangerous goods are stored, shall be warned that these products can be hazardous and that they are not to touch any container.

12.13.8.2 Construction sites shall be carefully secured. Local hazard potential shall be taken into account, and storage areas shall be evacuated if necessary. Construction sites shall be blocked off to ensure that unauthorized personnel or visitors do not have uncontrolled access to other warehouse areas.

12.13.8.3 Work such as welding, chiselling or drilling, or work that involves the use of non-sparkproof electrical tools shall not be carried out without the permission of the warehouse controller. Such work, and any other work that is likely to create a hazard, shall be regulated by a work permit procedure.

12.13.8.4 No work that requires hot cutting or welding, or that is likely to generate heat or sparks, shall be carried out within 10 m of any flammable or combustible material or packaging. If such work can only be carried out in a place where products are stored, all flammable or combustible items shall be removed to a distance of at least 10 m from the working area and the site shall be inspected to ensure that there is no possibility of fire, explosion or contamination from leaks, vapours, dust, rags or other materials. Work shall not start unless the atmosphere has been tested for the presence of flammable vapours and a satisfactory result of the test has been noted on the work permit. A shield shall be created around the work area. Fire-proof blankets shall be so arranged as to prevent sparks from falling to the ground, particularly if welding is being done overhead. Care shall be taken that drains in the area are covered to prevent the entry of weld splatter or the ignition of vapours. During welding or cutting operations, at least one person shall stand by with a fire extinguisher.

12.13.8.5 Precautions required during construction and maintenance work shall be documented and signed by both the warehouse controller and the contractor. When a work permit is required for an activity, this signed list of precautions shall form part of, and be kept with, the work permit.

12.13.8.6 Work permits shall be kept on file for at least five years.

12.14 Good housekeeping

12.14.1 General

12.14.1.1 Storage areas and all areas through which dangerous goods pass, shall be maintained in a safe and tidy condition, free from extraneous combustible material.

12.14.1.2 Combustible refuse, waste paper and empty containers shall not be allowed to accumulate and shall be disposed of promptly, following decontamination if appropriate. A separate storage area or bin shall be set aside for such materials, pending their removal from the premises. Wherever possible, all combustible waste shall be baled out and removed from the premises daily.

12.14.1.3 Access to entrances, exits and emergency equipment such as fire extinguishers and safety showers shall be kept free at all times. Floor surfaces, especially along escape routes, shall be even and non-slip. Wax polish shall not be used on floors.

12.14.1.4 A clear space shall be maintained around heaters, the vents of refrigerator compressor motors and air-conditioning units. The stacking of goods close to heating or cooling equipment shall be prevented by guard rails or other suitable devices.

12.14.1.5 Paints, flammable liquids and polishes for use on the premises shall, when not in use, be kept in metal containers, preferably outside the building. A separate metal container shall be provided for rags or cotton waste used in connection with polishes and cleaning fluids.

12.14.1.6 Goods shall not be stacked close to windows or where sunlight falling on them can present a fire hazard or cause deterioration of packaging or labelling. If an overhead sprinkler system is provided, the recommendations of the local fire authority shall be followed with regard to maximum permissible stacking heights.

12.14.1.7 Documentation shall be safeguarded against loss in fire by keeping documents in cabinets, safes or strong rooms that afford protection against fire.

NOTE SANS 951 covers fire-resistant record-protection equipment suitable for paper documents and magnetic media.

12.14.1.8 No vegetation shall be allowed to encroach to within 1 m of the perimeter of any storage area; grass shall be mowed regularly and shall not exceed 100 mm in height. Vegetation that is liable to dry out and become a fire hazard shall be kept short and cuttings shall be removed. Where

a warehousing site adjoins open veld that is liable to burn out of control in dry weather, appropriate arrangements shall be made (regular mowing or controlled burning) to prevent the spread of fire to the warehousing site.

12.14.1.9 Weed killers shall not be used in hazardous areas.

12.14.1.10 Stairways, ladders and catwalks shall be properly secured and maintained in a safe condition, free from oil and grease. They shall be inspected at regular intervals by a competent person, and any defects shall be rectified immediately.

12.15 Safety and first-aid facilities

12.15.1 Safety facilities

A sufficient number of easily accessible, appropriate safety facilities shall be provided. When so required by the authority administering this standard, these shall include at least

- a) emergency shower(s),
- b) breathing apparatus and escape masks,
- c) fire blankets,
- d) eye-wash stations, and
- e) first-aid facilities.

12.15.2 First-aid facilities

12.15.2.1 Each warehouse shall be equipped with (at least) basic first-aid facilities, and at least two employees shall be trained in the application of first aid in accordance with annex F.

12.15.2.2 First-aid facilities on the premises shall include

- a) eye-wash facilities,
- b) first-aid kits (see F.5),
- c) stretchers,
- d) blankets, including fire blankets,
- e) emergency kits and antidotes as indicated by the specific products stored, and
- f) emergency lighting and luminous tape.

12.15.2.3 The first-aid facilities shall be checked frequently by a designated person and maintained in a clean and serviceable condition. Records shall be kept of all checks and maintenance.

12.15.2.4 Hospitals or doctors (see 9.4.2) shall be contacted in the event of an emergency and, where appropriate, the label or Safety Data Sheet of the product responsible for a patient's condition shall be sent with the patient to the hospital or doctor.

12.15.2.5 First-aid facilities shall be so located that, in the event of an emergency, they are safely accessible in sufficient quantities, irrespective of the direction of the prevailing wind. In certain cases, duplicate sets might be required at opposite sides or ends of the area concerned.

12.15.3 Location of safety and first-aid facilities

12.15.3.1 Safety facilities and protective clothing shall be so located that, in the event of an emergency, they are safely accessible in sufficient quantities, irrespective of the direction of the prevailing wind. In certain cases, duplicate sets might be required at opposite sides or ends of the area concerned.

12.15.3.2 Owing to the high level of activity that normally occurs in and around the loading zones of warehouses, these areas shall receive special attention when the safety facilities and protective clothing to be provided are being decided upon.

12.15.3.3 The locations of all safety facilities and protective clothing shall be clearly indicated.

12.16 Maintenance of control measures

An employee shall ensure

- a) that all control equipment and facilities provided are maintained in good working order, and
- b) that thorough examinations and tests of engineering control measures are carried out at intervals not exceeding 24 months by an approved inspection authority or by a person whose ability to do the measurements and tests is verified by an approved inspection authority.

13 Health, safety and environmental policy, operating procedures and house rules**13.1 Health, safety and environmental policy**

13.1.1 The warehouse controller shall ensure that a clear policy on health, safety and environmental protection is issued by top management and is communicated to all employees.

13.1.2 The health, safety and environmental policy shall be supplemented and supported as necessary by clear, concise operating procedures, which shall be available to all employees.

13.1.3 The health, safety and environmental policy shall be supplemented and supported by house rules, which shall also govern the conduct of non-company personnel.

13.1.4 The health, safety and environmental policy shall be aimed at ensuring the safety and well-being of all employees, visitors and the community by preventing contamination of the atmosphere and the environment.

13.2 Operating procedures

13.2.1 Operating procedures shall be easy to read and understand and, to this end, shall be prepared in one of the official languages and in at least one other language indigenous to the region.

13.2.2 Operating procedures shall be posted at work places, and a system shall exist to ensure that all employees are trained in the operating procedures that they are required to follow (see 14.6).

13.2.3 Operating procedures shall include at least the following:

- a) **minimum personnel level:** at least two persons shall be required to be present in a warehouse at any one time, except that this provision may be relaxed if the safety of one person working alone is monitored, by means such as visual contact or regular reporting;
- b) **operating or working hours:** working hours, break times, rules on leaving the work area and rules for shift working shall be documented;
- c) **warehouse order:** products shall be stored in an orderly manner and only in the areas and warehouse facilities intended and designated for this purpose. Warehouse and traffic areas, personal hygiene areas and recreation areas shall be kept clean;
- d) **escape and rescue routes:** escape and rescue routes and emergency exits shall not be restricted and shall be kept unlocked at all times when the warehouse is occupied, to permit rapid escape from endangered areas;
- e) **work instructions:** work instructions shall be issued for specific activities, including
 - 1) work involving handling and disposal of hazardous materials,
 - 2) activities in hazardous or sealed-off areas, and
 - 3) individual activities that require supervision;
- f) **in-company traffic rules:** traffic rules for fork-lift trucks and persons in warehouse buildings and for vehicles in outdoor traffic areas on site shall be documented. Rules shall be laid down regarding the prohibition of vehicle or pedestrian entry, direction of traffic flow and one-way thoroughfares;
- g) **hazard information:** details shall be provided on hazardous materials, dangerous areas and technical facilities that can create hazards;
- h) **safety facilities and equipment:** all facilities and equipment that serve the safety of employees and the warehouse shall be detailed, together with their locations;
- i) **securing of construction sites:** the provisions of 12.13.8.2 shall be included in an operating procedure;
- j) **permits for special work:** the provisions of 12.13.8.3 shall be included in an operating procedure;
- k) **emergency information:** emergency information to the persons who are to be called out in the event of an emergency, and the authorities (hospital, fire, police, doctor, poison information centre), shall be detailed and published in the form of an emergency information poster. The poster shall be posted at appropriate locations, such as near the telephones most likely to be used in an emergency and in security gatehouses. The information given in the poster shall be updated as necessary and shall not be allowed to become obsolete; and
- l) **safety instructions:** safety instructions regarding employee behaviour in the event of emergencies shall be prepared and posted at conspicuous places throughout the premises and, when relevant to specific tasks, at work places. A booklet of general safety instructions shall be prepared and distributed to all personnel, and, if appropriate, to non-company personnel, for example temporary contractors. Safety-related rules from the other operating procedures shall be included in abbreviated form in the safety booklet. An example of a set of safety instructions is given in annex D.

13.3 Site rules

13.3.1 Site rules shall cover at least the following:

- a) operating times and contact persons outside of these times;
- b) control of access to the site, and in particular of non-company personnel to storage areas;
- c) the provision of information about potential hazards and emergency precautions to non-company personnel, before they are allowed to enter storage areas; and
- d) safety rules to be followed by non-company personnel when on site.

13.3.2 All visitors, including motor vehicle drivers and contractors, shall be informed of and required to obey all house rules.

14 Personnel and administrative issues

14.1 Selection of employees

The warehouse controller shall select employees in accordance with their intellectual and physical suitability, experience and formal qualifications.

14.2 Work-exposure record

14.2.1 An employer shall keep medical records and records of exposure information for every worker exposed to dangerous goods. The contents of the medical records shall be accessible only to an occupational medical practitioner, the worker himself, and any other person nominated in writing by the said worker.

14.2.2 An employer shall keep record of the investigation of each incident by completing the relevant form(s) as stipulated by the national department that deals with labour issues (see foreword). The worker involved is entitled to have a copy of such an investigation and the record shall be open for inspection by an inspector of the said national department.

14.2.3 An employer shall keep records for a minimum period of 30 years. If the employer ceases to operate, the records of all workers shall be handed over, or forwarded by registered post, to the relevant regional representative of the national department that deals with labour issues (see foreword).

14.3 Minimum requirements for health surveillance

14.3.1 An occupational medical practitioner shall carry out an initial health evaluation immediately before employment, or within 14 days of commencement of employment. The health evaluation shall comprise the following:

- a) an evaluation of the worker's medical and occupational history;
- b) a full physical examination; and
- c) any other examination (for example blood tests) that, in the opinion of the occupational medical practitioner, is desirable in order to do a proper evaluation.

14.3.2 A worker who handles dangerous goods on a regular or routine basis shall undergo a medical examination at intervals not exceeding two years, or at the discretion of an occupational medical practitioner.

14.3.3 A worker involved in the handling of dangerous substances shall be under medical surveillance if the exposure to any dangerous substances is such that an identifiable disease or adverse health effect can be related to the exposure.

14.3.4 A worker who is suffering from an ailment, or who is taking medication that would aggravate or suppress symptoms of poisoning by a dangerous substance, shall not be permitted to handle such a substance unless prior approval (endorsed on the worker's work exposure record card) has been obtained from an occupational medical practitioner.

14.3.5 If any symptoms of illness or discomfort (for example headache, dizziness, vomiting, diarrhoea, tightness of the chest), or if abnormal behaviour becomes apparent after a dangerous substance has been handled, an occupational medical practitioner shall be consulted immediately.

14.4 Organizational structure

14.4.1 A formal organizational structure shall exist. Key members of staff who have direct responsibility for warehousing operations, safety, environmental protection and security shall be identified and appointed in writing.

14.4.2 In large organizations, a contact person shall be nominated to act as media spokesperson in the event of an emergency.

14.4.3 A call-out roster, which ensures that key personnel are available at all times, shall be drawn up, posted and circulated as necessary. The call-out roster shall form part of the emergency plan (see clause 16 and annex G).

14.5 Job knowledge

14.5.1 The warehouse controller shall be trained and possess the knowledge necessary to carry out his function effectively, and shall, in particular, be familiar with the properties and hazards of goods stored, the symptoms of poisoning, and first-aid procedures.

14.5.2 Senior warehousing employees shall be trained and possess the knowledge necessary to carry out their functions effectively, and shall have been trained extensively in dealing with spillage and in firefighting. They shall be familiar with the properties and hazards of goods stored under their control, the symptoms of poisoning, first-aid procedures, and the protective clothing and equipment required for operations.

14.5.3 All other employees shall be trained and be aware of the symptoms of poisoning and the hazards associated with the handling of dangerous goods, and shall have a knowledge of the action(s) required in the event of a spill, a fire or poisoning.

14.6 Training

14.6.1 Before an employee starts work, he shall receive training from a competent person in at least the following:

- a) the nature of the work and the limits of the employee's responsibility and authority;
- b) the chain of command, including the name(s) of the person(s) responsible for the work area(s);
- c) the properties of, and hazards associated with, the products handled, and the safety precautions required;

NOTE This will include familiarization with the relevant Safety Data Sheets.

- d) storage plan and the need for separate and segregated storage of different types of product;
- e) first-aid measures, including emergency measures in the event of poisoning;
- f) emergency measures in the event of a leak or a spill, and disposal procedures, including instructions on the protective equipment and clothing to be used;
- g) emergency drills (see 14.7), including the location and use of fire protection equipment and what to do on hearing an alarm; and
- h) evacuation procedures including the importance of fire-doors, the meaning of safety signs and the sounds emitted by alarms.

14.6.2 The training shall be repeated, refreshed and updated as necessary at least once a year.

14.6.3 On every occasion on which training is given, the contents of the training and the date shall be confirmed in writing by means of the signature of each employee receiving training.

14.6.4 A system shall exist to ensure that additional training is given whenever a significant change takes place, for example when there is a change in the range of products handled and in potential hazards.

14.6.5 Selected employees shall receive comprehensive additional training in first aid.

14.6.6 In large warehouses where certain employees are designated as members of a firefighting team or fire brigade, training in firefighting shall be comprehensive and shall include, for example:

- a) starting and operating fire pumps;
- b) operating fire main and sprinkler valves and being thoroughly familiar with their location;
- c) running out and connecting fire hoses;
- d) fitting and handling nozzles, branch pipes, foam monitors and the system for foam induction;
- e) the correct use of mobile and portable fire extinguishers; and
- f) directing cooling water or foam correctly onto the target.

14.6.7 A sufficient number of employees shall receive the additional training described in 14.6.5 and 14.6.6 to cover leave periods, absences owing to sickness, and public holidays, and to ensure compliance with the regulations.

14.6.8 Records of all training conducted shall be kept for a minimum of 5 years.

14.7 Emergency drills

14.7.1 Appropriate emergency drills, which shall include practice evacuation of the premises, shall be carried out at least once annually, if possible in collaboration with the local emergency services, and shall include all personnel (see also SANS 10139).

14.7.2 Members of firefighting teams shall be required to carry out realistic fire drills on site, and to use the actual equipment they will be expected to use in a fire. It is recommended that, for example, foam concentrate be regarded by management as a consumable stock, and that up to 10 % of stock be used in practices in any one year.

14.8 Supervision

The warehouse controller shall ensure adequate supervision of workers with regard to all operations, and in particular the safe handling of dangerous substances.

14.9 Workplace hygiene

14.9.1 No eating, drinking or smoking shall be permitted in storage areas. "No smoking" signs shall be obeyed at all times.

14.9.2 Separate area(s) shall be designated or provided for eating, drinking and, if permitted in terms of company policy or health legislation, smoking.

14.9.3 Employees shall wash their hands before eating, drinking, smoking or using the lavatory, and after work.

14.9.4 All injuries, including minor burns, scratches and abrasions, shall receive immediate attention.

14.9.5 A regular supply of clean overalls, gloves and footwear for on-site wear shall be provided, and employees shall wear the designated clothing.

14.9.6 Personal protective equipment and facilities shall be kept clean and in good condition.

14.9.7 Washing facilities (showers and wash-hand basins with hot and cold water) shall be provided.

14.9.8 Lockers for storing personal clothing and property shall be situated away from storage areas, and shall not be the same lockers used to store work clothing and personal protective equipment; a dual, side-by-side, suitably labelled locker system is recommended.

15 Security

15.1 Access control

Unauthorized access to the warehouse shall be prevented at all times. If a warehouse is part of a larger complex of buildings, or stands in its own grounds, the perimeter of the property shall be protected, where practicable, by means of a wall or fence of height at least 2,5 m, that has, preferably, at least two strands or a coil of razor wire or similar protection on top. An appropriate entry-pass system shall be enforced. The number of gates in the perimeter wall or fence shall be the minimum necessary to allow normal operations, except that, if possible, emergency service vehicles shall be able to gain access to the warehouse from at least two sides.

The warehouse building itself shall be burglar-proofed as necessary. All doors shall be locked outside operating hours. All windows shall be closed securely outside operating hours, unless they are required to remain open for ventilation, in which case they shall be burglar-proofed. Names and contact telephone numbers of the persons to be called out in an emergency shall be given to security personnel, the local police and the local fire authority. There shall be a system to ensure that the persons called out have access to the necessary keys to buildings. All such keys shall be labelled.

15.2 Twenty-four-hour manning

If the warehouse contains toxic substances and is situated in a relatively heavily populated or environmentally sensitive area, and if the scale of the operation permits, 24-hour manning of the security function, with regular patrols, shall be carried out. In such a case, a procedure shall be instituted to verify that patrols actually take place, especially at night.

NOTE A useful device in this regard is a "key" system at various points around the site; such "keys", when turned, record the time, and hence a check is then available that patrols have in fact been conducted.

16 Emergency planning

16.1 When a fire breaks out in a warehouse that contains dangerous goods, the environment in general, and the neighbouring population in particular, are potentially at risk from the following, despite precautions taken:

- a) the spread of airborne pollutants, which might be toxic;
- b) contamination of water courses and ground water by run-off water from firefighting activities;
- c) contamination of the soil; and
- d) the possible spread of the fire itself, or the explosion of the warehouse.

It is therefore imperative that fire authorities, and other local or national authorities, be in possession of the fullest possible information regarding the activities of and stocks in the warehouse. While the internal operating procedures drawn up by the warehouse management are intended to promote the safe and efficient conduct of warehousing operations, they are insufficient in themselves to impart effective control in the event of a major fire, spill or other emergency. For this reason, it is essential that an emergency plan be drawn up to provide the necessary information and lay down the necessary procedures to protect the environment and the neighbouring population in the event of an emergency.

16.2 An emergency plan shall be drawn up by the warehouse controller for each warehouse, in consultation with the local fire authority and, as necessary, with other specialist advisers (see 18.2.1.1). The plan shall be reviewed and updated at least once a year and shall include the information listed in annex G. Current copies of the plan shall be circulated to the local fire authority and to all senior personnel likely to be called out in an emergency, and shall be kept accessible at all times at the main on-site security office or gatehouse, or at another convenient location on site, separate from the area(s) in which goods are stored. A system shall exist to ensure that copies of the plan are signed for on receipt and that outdated copies are collected and destroyed (or archived for reference purposes) as soon as they have been superseded.

17 Receipt and despatch

17.1 No goods listed in SANS 10228 as dangerous shall be accepted for storage, if Safety Data Sheets for the goods have not been provided by the supplier of the goods.

17.2 When dangerous goods are received, they shall be checked against the relevant invoice, delivery note, bill of lading or manifest, and any discrepancies shall be dealt with in a responsible and safe manner.

17.3 During receipt and prior to despatch, the packaging of dangerous goods shall be checked for integrity and leaks, and appropriate action taken. Any packages on which the labelling is missing or defective shall be set aside (see 12.11).

17.4 Before dangerous goods are received into warehousing, the person in charge of the receipt function shall ensure that they are packaged, marked and labelled in strict accordance with SANS 10229-1 and, when relevant, with SANS 10233, and that appropriate action is taken in the event of non-compliance.

17.5 The warehouse controller shall ensure that all necessary sampling and testing of received product consignments are completed before such products are permitted to be stored with pre-existing stocks.

17.6 Before dangerous goods are loaded for despatch by road or rail, the person in charge of the despatch function shall ensure that

- a) the packaging, marking and labelling provisions of SANS 10229-1 and, when relevant, the provisions for intermediate bulk containers of SANS 10233, have been complied with,
- b) the vehicle or wagon to be used for transportation is in a clean and proper condition, for the safe transport of such goods, and
- c) appropriate action is taken in the event of non-compliance.

17.7 When dangerous goods are despatched by road, the relevant provisions of SANS 10231 and SANS 10232-1 shall be complied with.

NOTE These include provisions for the necessary documentation, placarding and loading limitations, and operational provisions for road vehicles.

17.8 Road vehicles used for the transport of dangerous goods should be equipped with fire extinguishers, protective equipment and clean-up equipment for use by the driver in case of an incident.

17.9 Care shall be taken during receipt and despatch operations to ensure that incompatible dangerous goods are not allowed to come into contact with one another (see 12.8 and annex E). Where space permits, holding areas for incoming goods awaiting clearance before storage and for outgoing goods assembled and awaiting transport shall be clearly demarcated; product separation and segregation requirements and other product-specific requirements (such as avoidance of storage in direct sunlight) shall be complied with in these areas. A system shall exist that prevents the uncontrolled or indiscriminate simultaneous unloading or loading, in one place, of more than one vehicle at a time.

17.10 Each warehouse marshalling area shall have separate loading and unloading bays, to facilitate the safe, efficient and secure receipt and despatch of goods.

17.11 Vehicles shall not be left unattended while loading or unloading is in progress.

17.12 Vehicles powered by internal combustion engines shall not be permitted to enter any area from which a fork-lift truck powered by the same means is prohibited (see 11.4).

17.13 Vehicles awaiting loading shall remain at a safe distance from the loading point.

17.14 No smoking shall be allowed during loading or unloading, even when this takes place in the open air.

17.15 Personnel involved in loading and unloading shall wear appropriate protective clothing (see 12.3); all injuries, including minor burns, scratches and abrasions, shall receive immediate attention.

18 Waste disposal and post-fire clean-up

18.1 Waste disposal

18.1.1 General principles

18.1.1.1 All waste materials, including waste from leakage or spillage and obsolete stock, shall be disposed of in a safe and environmentally sound manner in accordance with

- a) documented operating procedures,
- b) the relevant national regulations and statutory provisions dealing with the prevention of pollution (see foreword), and
- c) "duty of care" principles (see foreword).

18.1.1.2 Under no circumstances shall product leakage or spillage be flushed direct or be allowed to flow direct into the surface water drainage system or into a sewer or into any water course.

NOTE See the provisions for spillage containment given in 8.4.

18.1.1.3 Where compressed gases are involved, the owner or supplier of the cylinders shall be consulted for technical assistance.

18.1.2 Waste associated with leakage or spillage

18.1.2.1 Waste normally consists of

- a) collected product,
- b) contaminated absorbent materials, and
- c) empty containers.

18.1.2.2 All materials that are contaminated with dangerous substances and all empty packaging (see 3.5) should preferably be sent to a registered disposal company for disposal at a site which should be registered as a hazardous waste landfill site with the department that deals with waste management and disposal (see foreword). Alternatively, empty packaging (with the exception of plastics containers that previously contained pesticides) can be sent to a registered reprocessing company in terms of SANS 10406. If reprocessing is impossible or undesired, empty containers shall be decontaminated or triple-rinsed (see SANS 10206) and then shattered (in case of glass containers), punctured (in case of plastics and metal containers), or so otherwise rendered unserviceable as to prevent re-use, before disposal. Aerosol dispensers shall not be punctured.

18.1.2.3 Empty plastics containers that previously contained a pesticide shall not be reprocessed. Such containers that have been rendered unserviceable could be considered for recycling into other products such as building construction materials (see also SANS 10206).

18.1.2.4 Thermal destruction of dangerous goods waste shall only be carried out in a facility authorized by the national department that deals with waste management and disposal (see foreword).

18.1.3 Obsolete stock

Advice on the disposal of obsolete stock shall, in all instances, be obtained from the suppliers, and disposal shall be done in accordance with the relevant provisions of 18.1.1 and 18.1.2.

NOTE The Safety Data Sheets issued by the suppliers are of considerable help in this regard.

18.2 Post-fire clean-up

18.2.1 General

18.2.1.1 Contingency plans, covering the aftermath of a fire, shall be drawn up by the warehouse controller in consultation with the product manufacturer or supplier, the local fire authority and, as necessary, with other specialist advisers, and shall form part of the emergency plan.

18.2.1.2 When drawing up contingency plans, the parties concerned shall ensure that the responsible person(s) or function(s) (for example in terms of the regulations), who will be in charge of the clean-up operations, are identified unambiguously.

18.2.1.3 The cleaning-up process shall be carried out in such a way as to minimize environmental pollution, while at all times ensuring the personal safety of the individuals involved.

18.2.1.4 Contingency plans shall address the points listed in 18.2.2 to 18.2.7 (inclusive), amended as necessary to reflect the nature of the specific products involved in the fire.

18.2.1.5 The role of insurers should be addressed in contingency plans. In particular, it should be noted that under certain circumstances, insurers' permission may be needed before a post-fire clean-up is undertaken. Failure to obtain such permission could invalidate a policy. Warehouse controllers are therefore advised to consult with their insurers at an early stage with a view to obtaining timely permission to carry out such a clean-up. If at all possible, written permission should be obtained from insurers before an emergency occurs, to enable the necessary actions to be taken without delay.

18.2.2 Initial actions

18.2.2.1 Where so required in terms of the regulations, the appropriate government departments and regulatory authorities shall be informed of the situation.

18.2.2.2 The burnt-out area shall be isolated and cordoned off. Appropriate warning signs shall be posted. Unauthorized entry shall be prevented; only personnel involved directly in the clean-up shall be admitted to the area.

18.2.2.3 Local authorities shall be notified of the plan for the clean-up, and, where the involvement of local authorities in the clean-up is mandatory, warehouse personnel shall give their full co-operation.

18.2.2.4 Eating and drinking shall be prohibited in the clean-up area.

18.2.2.5 Before anyone is allowed to enter the clean-up area, appropriate arrangements shall be made to ensure that toxicants cannot be carried out of the area on feet or on wheels. Foot-baths and means of scrubbing wheels shall be provided, as necessary, at exit points, and the washing water shall be disposed of in an appropriate manner.

18.2.2.6 All personnel involved directly in the clean-up shall be informed of the nature of the hazards that may be encountered, and shall be provided with and required to wear appropriate

protective clothing and respiratory protection (see 12.3). Arrangements shall be made for the decontamination of protective clothing and equipment after use.

18.2.2.7 Bund walls shall be so constructed as to minimize contamination due to rainwater run-off from the area, and, when appropriate, tarpaulin covers shall be used.

18.2.2.8 The person in charge of the clean-up operation shall ensure that he is familiar with the products involved and with the associated hazards; Safety Data Sheets, suppliers, and other specialist advisers shall be consulted as necessary.

18.2.3 Separation of hazardous waste into disposal categories

18.2.3.1 Hazardous waste shall be separated into appropriate categories, according to their safe disposal characteristics, to minimize the quantity of hazardous waste to be disposed of.

18.2.3.2 In certain circumstances, the process of proving waste to be uncontaminated can be so long and costly (owing to the need for analysis) that it is environmentally preferable, as precautionary principle, and more cost-efficient to treat the waste as contaminated.

In a standard of this nature, it is impossible to cover all combinations of circumstances, and the person in charge shall make the final decision as to the categories of debris to be separated. The following broad categories are suggested:

- a) retained fire water;
- b) solid and liquid product waste;
- c) suspected contaminated waste;
- d) obviously contaminated waste;
- e) suspected uncontaminated waste;
- f) damaged packaging;
- g) undamaged packaging; and
- h) unknown material.

CAUTION — Care shall be exercised in the subsequent treatment of debris and product packs that are thought to be uncontaminated. Where waste cannot be easily categorized, it is essential to assume that the waste or an identified component of it is both highly hazardous and toxic until proven otherwise.

18.2.4 Safe treatment and disposal of waste

The various categories of hazardous waste shall be transported to an appropriate landfill site that complies with the relevant national legislation and provisions, or any other regulatory requirements of the relevant provincial and local governments (also see 18.1.2.2 to 18.1.2.4).

18.2.5 Assessment of environmental contamination

Sampling and analysis of soil both on site and adjoining property, open water courses and boreholes shall be carried out to determine the extent of contamination. Other appropriate follow-up actions shall be taken in consultation with local and national authorities.

NOTE Determination of the extent of contamination, and therefore the degree to which cleaning up is required, can be facilitated from a knowledge of the conditions that existed before the contamination occurred. It is of great importance to know what contaminants to analyse for, whether air quality monitoring will be required, etc.; careful attention to such details is required in the consideration of site location (see 5.3) and in emergency planning (see clause 16 and annex G).

18.2.6 Decontamination of buildings, equipment and clothing

Buildings, concrete slabs, vehicles, tools, equipment and clothing shall be decontaminated as necessary and in an appropriate manner. All items shall, in general, be rinsed or otherwise treated until known contaminants have been removed. Equipment and clothing shall, in general, not be allowed to leave the site unless they have been decontaminated and vehicles shall not be allowed to leave the site unless their wheels have been decontaminated. As a general principle, items should be regarded as contaminated until proven otherwise. Discarded protective clothing shall be disposed of in an appropriate manner.

18.2.7 Demolition of buildings and installations

When demolition is necessary, it shall be carried out by a competent contractor who has experience of demolition in post-fire circumstances where dangerous goods have been involved. All demolition shall be carried out under the supervision of a competent authority (for example the warehouse controller or the local fire authority). As part of the emergency planning, the warehouse controller shall consult with local demolition contractors and select in advance, a short list of competent contractors.

CAUTION — The demolition process can itself create additional environmental hazards owing to, for example, the evolution of dust (see part E of SANS 10400:1990).

19 Routine safety checks

19.1 General

19.1.1 The warehouse controller is responsible for ensuring that all necessary safety features are available and in effective working order and that no undue risk of fire, explosion or other hazard is present. A formal schedule of routine safety checks to be carried out shall be drawn up, appropriate to the size, type and complexity of the warehousing operation. The specific items to be included and their required checking frequency will vary from warehouse to warehouse. An example of a schedule of routine safety checks is given in annex D.

19.1.2 Although much routine checking can be undertaken during working hours by suitably trained personnel, formal agreements shall be made with manufacturers, agents, installers, accredited servicing organizations or fire authorities, as necessary, to ensure that regular checks are carried out. Where necessary, routine checks shall be carried out after business hours and on non-working days.

19.1.3 Certain testing, maintenance and servicing shall be carried out in accordance with the relevant standards of the SABS Standards Division, in particular

- a) the routine testing and maintenance of automatic fire detection, fire protection and alarm systems, which shall be carried out in accordance with SANS 10139, and
- b) the maintenance and service (see 10.2.3) of portable fire extinguishers and fire hose reels, which shall be carried out in accordance with SANS 10105-1 and SANS 10105-2 respectively.

19.1.4 External safety inspections shall be conducted in accordance with 19.2.

19.1.5 The results of all checks and inspections shall be documented, and shortcomings rectified as soon as is practicable.

19.1.6 The list of items to be checked shall be updated annually.

19.1.7 All fire protection and safety-related equipment that is not in routine daily use shall be checked each time after it has been used and either be replaced or returned to service in full working order

a) as soon as is practicable, and

b) as appropriate, in accordance with the schedule.

19.2 External safety inspections

19.2.1 Initial inspections before warehousing operations start

New warehouses, extensions to existing warehouses, and warehouses in which a change of occupancy brings a building or site within the scope of this standard, shall be inspected by the local fire department for compliance with the provisions of this standard, and a certificate of compliance shall be obtained from the local authority (see foreword) before warehousing operations start (see also 5.5.1 and 5.5.2).

NOTE Environmental Impact Assessment approvals may require initial and periodic inspections and reports by the environmental officer to the issuing authority.

19.2.2 Annual inspections

The local fire department shall inspect warehouses annually for compliance with the provisions of this standard, and a certificate of compliance shall be obtained from the local authority (see foreword) before warehousing operations may continue.

Annex A

(normative)

Quantities of the various classes and divisions of dangerous goods for which the provisions of this standard apply

The provisions of this standard apply to the storage of the following quantities of dangerous goods (see table A.1):

NOTE The quantities specified below refer to the quantity of the product, excluding the packaging.

Table A.1 — Quantities of dangerous goods

1	2	3
Class	SANS 10228 classification	Quantity
Class 1	Explosives	All quantities
Class 2	Gases: Division 2.1: flammable gases Division 2.2: non-flammable non-toxic gases Division 2.3: toxic gases	Cylinder quantities > 50 kg Cylinder quantities > 500 kg All quantities
Class 3	Flammable liquids: Category 1: closed-cup flashpoint < 23 °C and initial boiling point ≤ 35 °C Category 2: closed-cup flash point < 23 °C and initial boiling point > 35 °C Category 3: closed-cup flash point ≥ 23 °C and ≤ 60 °C	> 100 L > 500 L > 1 000 L
Class 4	Flammable solids: Division 4.1: flammable solids, self-reactive substances and solid desensitized explosives (category 1 and 2) Division 4.2: substances liable to spontaneous combustion (pyrophoric, and self-heating substances) Division 4.3: substances that, on contact with water, emit flammable gases	> 250 kg All quantities All quantities
Class 5	Oxidizing substances and organic peroxides: Division 5.1: oxidizing substances Division 5.2: organic peroxides	> 200 kg All quantities
Class 6	Toxic and infectious substances: Division 6.1: toxic substances: Category 1 Category 2 Category (3 and 4) Division 6.2: infectious substances	> 5 kg > 50 kg > 500 kg All quantities
Class 7	Radioactive material	All quantities
Class 8	Corrosives (acids and bases): Category 1 Category 2 Category 3	> 50 kg > 200 kg > 1 000 kg
Class 9	Miscellaneous dangerous goods	> 210 kg

Annex B

(normative)

Permitted storage quantities per fire section, and the firefighting water supply requirements

B.1 The size of a fire section in a building or in a covered outdoor storage yard depends on

- a) the specific hazard potential of the goods to be stored,
- b) the fire detection and alarm systems installed, and
- c) the firefighting capabilities and, in particular, the available firefighting water supply (quantity and pumping rate).

B.2 Table B.1 shows, for each SANS 10228 product class, the quantities of product that may be stored in a fire section, and the associated firefighting water supply requirements.

B.3 When products of different SANS 10228 classes are to be stored in one fire section (subject to the product separation and segregation provisions of 12.8), the provisions of table B.1 that relate to the most hazardous product class shall apply.

B.4 The maximum storage quantities permissible in uncovered outdoor storage yards shall be determined in consultation with the local fire authority, after all relevant circumstances have been taken into account.

NOTE Certain classes of goods may not be stored in uncovered outdoor storage yards or in multi-storey warehouses – see 7.2.2 and 7.5.2 respectively.

Table B.1 — Permitted storage quantities per fire section, and firefighting water supply requirements by SANS 10228 product class

1	2	3	4	5	6	7	8	9	10
SANS 10228:2006 class (see annex B)	Firefighting water supply requirements								
	Storage quantity of dangerous goods t								
	>1 ≤10	>10 ≤50	>50 ≤200	>200 ≤400	>400 ≤800	>800 ≤1 200	>1 200 ≤1 600	>1 600 ≤2 400	>2 400
1	*	*	*	*	*	*	*	*	*
2	B	C	C	C	C	X	X	X	X
3 (FP ≤ 23 °C)	B	B	B	B	C	C	C	X	X
3 (FP > 23 °C)	A	B	B	B	B	B	C	C	X
4.1	B	B	B	X	X	X	X	X	X
4.2	B	B	C	C	X	X	X	X	X
4.3	B	B	C	C	X	X	X	X	X
5.1	B	B	B	C	X	X	X	X	X
5.2	B	B	B	X	X	X	X	X	X
6.1	A	A	A	A	B	B	B	B	X
6.2	*	*	*	*	*	*	*	*	*
7	*	*	*	*	*	*	*	*	*
8.1 or 8.2	A	B	B	B	B	B	C	C	C
9	A	A	A	A	B	B	B	B	C
Legend: A: Firefighting water supply of ≥ 1 200 L/min shall be provided. B: Firefighting water supply of ≥ 1 600 L/min shall be provided. C: Firefighting water supply of ≥ 3 200 L/min shall be provided. X: Storage of these quantities is not permitted within one fire section. * : These materials are subject to special regulations.									

Annex C

(informative)

Water retention volumes in spillage containment areas

C.1 An overall spillage containment plan could involve primary, secondary and tertiary collection areas or catch basins. Primary collection is normally accomplished by means of spill trays under storage racks. Secondary and tertiary collection areas are normally larger areas into which spillage can be directed as necessary for further treatment. The degree to which any given secondary or tertiary collection area requires to be bunded or otherwise contained depends on the quantities of firefighting water or spillage likely to be encountered and required to be contained, even temporarily, in that area. These quantities in turn depend on the quantities and hazardous characteristics of the products stored, and on the type of fire protection system used, for example whether foam or water is the main extinguishing agent used and whether or not a sprinkler system is installed.

C.2 Containment requirements can be expressed

- a) on an arbitrary basis (for example by requiring that an area be bunded to a certain height above floor level), or
- b) as a percentage of the total volume of liquid products stored, or
- c) by attempting, from experience, to assess the likely requirements in each particular case from a knowledge of all the variables concerned.

C.3 In the body of this standard, minimum permissible provisions are laid down on the basis of the first two criteria above. It is desirable, nevertheless, to give some rules of thumb that can be applied by warehouse designers who wish to relate their spillage containment arrangements more closely to their specific circumstances.

C.4 The following rules of thumb are used by several chemicals companies for large warehouses equipped with sprinklers:

Type of hazardous material	Fire water retention volume (m³/t of material)
Explosive or highly flammable substances	3
Substances liable to spontaneous combustion	5
Flammable substances, flash point < 55 °C	5
Flammable solids	5
Ecotoxic substances, such as pesticides, wood preservers and organochlorine derivatives	5

For smaller warehouses, not equipped with sprinklers, these figures are normally increased by a factor of 10.

C.5 Another way of estimating fire retention volumes for large warehouses equipped with sprinklers is proposed in the *Fire protection handbook* (see Bibliography). This method considers the design of the sprinkler and attempts to estimate the water demand in a fire, assuming that the sprinkler fully extinguishes the fire.

Annex D
(informative)

Example of a routine safety checking schedule

D.1 Introduction

The example of a routine safety checking schedule can be used as a guide when a schedule of the type(s) and frequency(ies) of checking required is completed.

D.2 Daily checks

D.2.1 The premises could be inspected daily to ensure that

- a) all exit doors are unlocked and readily available for use, or are capable of being opened in the event of an emergency,
- b) all emergency fastenings are working efficiently,
- c) all escape routes are clear of obstructions,
- d) fire-doors and fire-shutters are not wedged or propped open, obstructed or otherwise prevented from operating,
- e) in the case of illuminated signs, that they are adequately illuminated and, where two power supplies are provided, that both are operative, and
- f) there are no obvious fire hazards, such as accumulated waste.

NOTE Particular care is necessary in this regard if contractors have been working on the premises.

D.2.2 All parts of the premises could be checked regularly throughout each working day, with particular attention being paid at the end of the day to cloakrooms, and to those parts of the premises not normally visited by staff. A daily inspection shall be carried out after the close of business to ensure that the premises are left in a safe condition. Electrical services that are not needed when the premises are unmanned shall be turned off at the mains, and their plugs shall be removed from socket-outlets.

D.2.3 Daily visual checks could be carried out in respect of the fire warning system, emergency and escape lighting and firefighting equipment, so that any necessary corrective action can be initiated without delay. The following shall be ensured in particular:

- a) that the control panel of any fire detection or alarm system indicates normal operation and, if any fault is indicated, that it has been logged and the appropriate action(s) has/have been taken;
- b) that, where applicable, the emergency and escape lighting system(s) is/are operative;
- c) that, where applicable, the control panel for any central battery system or generator intended to provide power for emergency lighting or other emergency facilities indicates normal operation and, if any fault is indicated, that it has been logged and the appropriate action(s) has/have been taken;
- d) that any fault in a fire detection or alarm system or in a power supply, lighting or sprinkler system that was recorded the previous day has received attention; and
- e) that all portable fire extinguishers and hose reels are in place and not obstructed, discharged or damaged, and that any extinguisher used in a fire, or for training, has been recharged.

D.3 Weekly checks

D.3.1 General

In addition to the daily checks listed in D.2, weekly checks could be carried out as given below.

D.3.2 Fire detection and alarm systems

The following could be ensured:

- a) the control equipment's ability to receive a fire signal and to initiate the evacuation procedure, recording which trigger device has been used;

NOTE Each fire zone should be tested at least once every three months.

- b) that any standby batteries are in good condition and that the fuel, oil and coolant levels of any standby generators are correct, topping up as necessary; and
- c) that, if paper and ink or ribbon are used, the reserves are adequate for at least two weeks' normal usage.

D.3.3 Sprinkler systems

The following could be ensured:

- a) that a water supply is available and, where applicable, is at the required pressure;
- b) that each water pump alarm is operative and has been sounded for at least 10 s;
- c) that fuel and oil levels of diesel engines used to power automatic pumps are correct;
- d) that automatic pumps start when the water pressure is reduced to its lowest specified level and that, if the pumps are powered by a diesel engine, the oil pressure and the flow of cooling water through open-circuit cooling systems or the water level in the primary circuit of closed-circuit cooling systems are correct, and that the engine will restart when the manual start test button is used; and
- e) that the electrolyte level and density of all lead-acid battery cells are correct and, if the density is low, that the battery charger is working correctly.

D.3.4 Gaseous, foam and powder extinguishing systems

The following could be ensured:

- a) that all pressure gauges work correctly;
- b) that all operating controls are both properly set and accessible;
- c) that all indicators are functioning;
- d) that the equipment, particularly pipework and nozzles, is substantially free from dust and dirt, is not physically damaged or leaking, and is in its designated location;
- e) that the fire risk and its enclosure have not changed; and
- f) that the quantity of extinguishing medium is correct and, for foam systems, that the water supply is available and at the correct pressure.

D.3.5 Smoke control systems

Simulate actuation of the system and ensure that any fans and powered exhaust ventilators operate correctly, that smoke dampers close or open as intended, that natural exhaust ventilators open and that automatic smoke curtains move into position.

D.4 Monthly checks

D.4.1 General

In addition to the weekly checks listed in D.3, monthly checks could be carried out as given below.

D.4.2 Fire detection and alarm systems

Start up any standby generator by simulating failure of the normal power supply, and allow the standby generator to energize the system for at least 1 h. During this period, monitor the system for any malfunctioning caused by the generator. After restoring the normal supply, ensure that the charging arrangements for the generator starting battery are functioning correctly, top up the oil and coolant levels if necessary, and fill the fuel tanks.

D.4.3 Emergency and escape lighting systems

The following could be ensured:

- a) after simulating a failure of the supply to the normal lighting, that all luminaires and exit signs function correctly, and if the standby supply is from a generator with back-up batteries, that all luminaires and exit signs function correctly even if the generator is prevented from starting; and
- b) after restoring the supply to the normal lighting, that
 - 1) indicator lamps or devices of self-contained luminaires or internally illuminated exit signs show that the normal supply has been restored,
 - 2) indicator lamps or devices to central battery systems show that the normal supply has been restored, and that the charging arrangements are functioning correctly, and
 - 3) the charging arrangements for any battery for starting a generator are functioning correctly, that the oil and coolant levels have been topped up, and that the fuel tanks are full.

D.4.4 Firefighting equipment and systems

Ensure that all personnel who might have to operate the firefighting equipment or system(s) are properly trained and authorized to do so, and in particular that new employees have been instructed in their use. Ensure that the water supply and pressure are adequate. In the case of hose reels, ensure that there are no leaks, and that drum assemblies are free to rotate on their spindles. In the case of fire hydrants, ensure that there are no obstructions impeding access, that the indicator plates or markings are in position, and that the isolating valves are locked open.

D.5 Six-monthly checks

D.5.1 General

In addition to the monthly checks listed in D.4, six-monthly checks could be carried out as given below.

D.5.2 Fire-doors

The following could be ensured:

- a) that door leaves are not structurally damaged or excessively bowed or deformed;
- b) that gaps between the door leaf and the frame are not so small as to be likely to bind, or so large as to prevent effective sealing against fire and smoke; and
- c) that hanging devices, securing devices, self-closing devices and automatic release mechanisms are operating correctly.

D.5.3 Fire mains

The following could be ensured:

- a) that inlets, landing valves, drain valves, door hinges and locking arrangements for inlet and landing valve boxes are ready for immediate use, and that spindles, glands and washers are in a satisfactory condition; and
- b) for wet mains, that booster pumps and their associated mechanical and electrical apparatus are functioning correctly, and that storage tanks are full of clean water.

D.5.4 Fire detection and alarm system, sprinkler systems, and extinguishing systems

Ensure that appropriate six-monthly inspections and tests of the fire detection and alarm system, of the sprinkler system and of the extinguishing systems are carried out by competent persons (the manufacturer, agent, installer or the fire authority), and that any defects found are logged and the necessary action is taken, and that certificates of satisfactory testing are received and retained on file.

D.6 Yearly checks

In addition to six-monthly checks listed in D.5, it could be ensured that appropriate annual inspections and tests of the following are carried out by competent persons (the manufacturer, agent, installer or the fire authority), and that any defects found are logged and the necessary action is taken, and that certificates of satisfactory testing are received and retained on file:

- a) fire detection and alarm systems;
- b) self-contained luminaires with sealed batteries, if more than three years old;
- c) sprinkler systems;
- d) smoke control systems;
- e) fire hydrants;

- f) fire mains;
- g) portable fire extinguishers;
- h) hose reels; and
- i) gaseous, foam and powder extinguishing systems.

In addition, check any stocks of foam concentrate or solution, and that all licences and permits, relevant to the storage and transportation of dangerous goods, are in order.

D.7 Three-yearly checks

In addition to the yearly checks listed in D.6, it could be ensured that appropriate three-yearly inspections and tests of the emergency and escape lighting, the sprinkler systems and the lightning protection system are carried out by competent persons (the manufacturer, agent, installer or the fire authority), and that any defects found are logged and the necessary action is taken, and that certificates of satisfactory testing are received and retained on file.

D.8 Five-yearly checks

In addition to three-yearly checks listed in D.7, it could be ensured that the electrical systems of fire safety installations are checked for compliance with the provisions of SANS 10142, and that any defects found are logged and the necessary action is taken, and that certificates of compliance are received and retained on file.

D.9 Records

Records of all safety checks could be kept on file for reference purposes and inspection by the relevant appropriate authority or insurance.

Annex E (normative)

Dangerous goods compatibility chart for storage and special provisions

E.1 General

E.1.1 Segregation and separation (see 12.8) of dangerous goods during storage shall be based on the hazard class, division and subsidiary risk diamonds displayed on the packaging. Furthermore, cognisance shall be taken of the reactivity of individual substances with each other, even if segregation and separation are not indicated in table E.1.

E.1.2 Segregation and separation in multi storage warehouses shall conform to the requirements of the storage compatibility chart in table E.1 and the special provisions according to hazard class in E.2.

Table E.1 — Compatibility chart for storage

Class	1	2.1	2.2	2.3	3	4.1	4.2	4.3	5.1	5.2	6.1	6.2	8 acid	8 base	9
1	P1														
2.1									P3/S	S			S	P6/S	
2.2									P3/S						
2.3									P3/S	P3/S			S	S	
3									P4/S	S	P5		P2/S	P2/S	
4.1									S	S			S	S	
4.2									S	S			S	S	
4.3									S	S			S	S	
5.1		P3/S	P3/S	P3/S	P4/S	S	S	S			S	S	S	S	
5.2		S		P3/S	S	S	S	S			S	S	S	S	
6.1					P5				S	S			P2/S	P2/S	
6.2									S	S			S	S	
8 acid		S		S	P2/S	S	S	S	S	S	P2/S	S		P7/S	
8 base		P6/S		S	P2/S	S	S	S	S	S	P2/S	S	P7/S		
9															

Provisions:

P1: See 12.8.2.2.

P2: See 12.8.5; 12.8.8.3(b) and 12.8.8.4

P3: See 12.8.6; 12.8.8.1(c); 12.8.8.2 and E.2.3.1.

P4: See 12.8.6; 12.8.8.1(c); 12.8.8.2.

P5: See 12.8.5; 12.8.8.1(a) and 12.8.8.1(b).

P6: See E 2.3.1 and E.2.3.3.

P7: See 12.8.5.2.

Empty black blocks indicate separation.

Black blocks with a “P” indicate special provisions.

Black blocks with an “S” indicate segregation.

Amdt 1

E.1.3 The chemicals list in table E.2 is not meant to be exhaustive, but serves as a quick reference to commonly used chemicals that are incompatible.

Table E.2 – Incompatibility of commonly used chemicals

1	2
Substance	Incompatible substance
Ammonium nitrate	Tetranitromethane Dichloroisocyanuric acid Trichloroisocyanuric acid – or any <ul style="list-style-type: none"> • bromate • chlorate • chlorite • hypochlorite • chloroisocyanurate • inorganic nitrite
Calcium hypochlorite and its mixtures (dry or hydrated)	Ammonium nitrate Dichloroisocyanuric acid Trichloroisocyanuric acid – or any <ul style="list-style-type: none"> • chloroisocyanurate
Class 6	Nitromethane
Concentrated strong acids	Concentrated strong bases
Cyanide compounds	Acids

E.2 Special provisions applicable to all classes

E.2.1 General

Unless otherwise specified, goods of different hazard classes shall be segregated by an air space of at least 100 mm or by an approved segregation device, or non-dangerous goods. Liquid dangerous goods of one class shall not be stored above dangerous goods of another class.

E.2.2 Provisions applicable to class 1

Storage of explosives of class 1 may only be included by prior written permission from the competent authority on explosives (see foreword) unless specifically excluded in terms of the relevant national legislation.

E.2.3 Provisions applicable to class 2

E.2.3.1 Gases of class 2 in cylinders and pressure containers shall comply with the provisions of SANS 10263–2.

E.2.3.2 When flammable gasses of division 2.1 and toxic gasses of division 2.3 are stored, sufficient ventilation shall be provided to prevent the build-up of gases.

E.2.3.3 Aluminium cylinders shall be separated from class 8 bases.

NOTE See 12.8.9 for the storage requirements for aerosol dispensers.

E.2.4 Provisions applicable to class 4

E.2.4.1 Self-reactive substances of division 4.1 shall be shielded from direct sunlight.

E.2.4.2 When a self-reactive substance of division 4.1 is stored in areas covered with sheets, the sheets shall be of material that is impermeable and non-combustible.

E.2.4.3 Self-reactive substances of division 4.1 shall be stored so as to be readily accessible, and not stacked on top of other goods.

E.2.4.4 Flammable solids of division 4.1 shall be subdivided in stacks of not more than 5 000 kg, with a space of at least 500 mm between stacks, or segregated by non-hazardous goods.

E.2.4.5 Contact of division 4.3 substances with water shall be avoided.

E.2.5 Provisions applicable to class 5

E.2.5.1 There shall be no exposed wood in the area where organic peroxides of division 5.2 are stored.

E.2.5.2 Packages containing organic peroxides of class 5.2 shall be so stored as to be readily accessible.

E.2.5.3 Organic peroxides of division 5.2 shall be subdivided in stacks of not more than 5 000 kg, with an air space of at least 500 mm between stacks.

E.2.6 Provisions applicable to class 6

E.2.6.1 Toxic substances of division 6.1 shall not be stored together with foodstuffs or stock feeds.

E.2.6.2 Packages containing infectious substances of division 6.2 shall be stored so that they are readily accessible, and shall not be stored with foodstuffs or stock feeds.

E.2.7 Provision applicable to class 7

The storage of radioactive material shall be in accordance with the national legislation on radioactive material (see foreword).

E.2.8 Provisions applicable to class 8

See 12.8.5.2.

Annex F

(normative)

First aid

F.1 General

F.1.1 The simple mnemonic ABC: A (airway) – B (breathing) – C (circulation) will help to keep the majority of poison victims alive until medical help arrives.

F.1.2 Speed is essential in the treatment of any contamination incident, since contamination can result in poisoning, especially when the victim has been exposed to a highly toxic pesticide.

F.1.3 Symptoms of poisoning can either be localized, for example irritation of the throat, nose, skin or eyes, or be more general. The appropriate first-aid measures depend to some extent upon the route by which the pesticide has entered the body (see F.2.2).

F.2 Requirements for untrained persons

F.2.1 Immediate action

F.2.1.1 Move the patient away from the contaminated area.

F.2.1.2 Keep the patient calm and comfortable and immediately either **summon a medical practitioner or take the poison victim to a medical practitioner**. If the patient can walk, allow him to do so only with assistance.

F.2.1.3 If the patient is unconscious, turn him onto his right side with his right leg straight, his left leg drawn up and his head so bent back that the respiratory tract is kept clear; loosen the clothing round the neck, chest and abdomen, and keep the patient quiet and lightly covered.

F.2.1.4 Follow the applicable procedures given in F.2.2.1.2, F.2.2.2.2, F.2.2.3.2 and F.2.2.4.2.

F.2.2 Routes of poisoning and action to be taken

F.2.2.1 Inhalation

F.2.2.1.1 Symptoms

Symptoms of exposure by inhalation might include headache, dizziness, nausea, sore throat, anxiety, and tightness of the chest.

F.2.2.1.2 Action

Move the patient to an area where there is fresh air, and loosen the clothing round the patient's throat and neck. Seek medical attention immediately, and show the substance label to the medical practitioner if possible.

F.2.2.2 Ingestion**F.2.2.2.1 Symptoms**

Although accidental ingestion of a toxic substance seldom happens, it might occur owing to contamination of eating utensils, food or drinking water. Ingestion of a toxic substance often causes nausea, vomiting, abdominal pains and diarrhoea.

F.2.2.2.2 Action

F.2.2.2.2.1 Do not give the patient anything to drink, unless this is specified on the substance label.

F.2.2.2.2.2 Do not induce vomiting, unless specified on the substance label.

F.2.2.2.2.3 If the patient vomits spontaneously, clean out his mouth and throat. Retain the vomit for analysis.

F.2.2.2.2.4 Seek medical attention immediately, and show the substance label to the medical practitioner if possible.

F.2.2.3 Skin contact**F.2.2.3.1 Symptoms**

Although many toxic substances only irritate the skin, some can penetrate intact skin rapidly, even if no skin irritation is experienced. Many toxic substances are absorbed through the skin, particularly on the scalp, at the back of the neck, on the soles of the feet and other exposed skin areas. Symptoms of poisoning include headache, nausea, tiredness, irritability, anxiety and abnormal behaviour. Symptoms are often delayed.

F.2.2.3.2 Action

F.2.2.3.2.1 If a pesticide comes into contact with an operator's skin,

- a) remove the contaminated clothing immediately, and
- b) rinse the affected area with plenty of clean water and seek medical attention. A person assisting the patient by rinsing the affected area shall wear clean chemical-resistant gloves.

F.2.2.3.2.2 When an operator becomes grossly contaminated, even if operations are incomplete,

- a) remove the patient from the operation area,
- b) remove protective clothing and protective equipment immediately,
- c) wash the affected area with plenty of clean water,
- d) put on clean clothes, and
- e) seek medical attention immediately, and show the pesticide label to the medical practitioner if possible.

F.2.2.4 Eye contact

F.2.2.4.1 Symptoms

The patient might not experience severe discomfort, but first-aid shall nevertheless be carried out immediately.

F.2.2.4.2 Action

Rinse the eyes with plenty of clean water for at least 10 min and seek medical attention. Show the pesticide label to the medical practitioner if possible.

F.3 Requirements for trained persons

F.3.1 Follow the instructions given in F.2. In addition, advise the medical practitioner if it is suspected that the substance ingested might contain petroleum distillates or other hydrocarbon solvents.

F.3.2 If the patient experiences difficulty in breathing, administer oxygen until medical help arrives. Apply artificial respiration if breathing has stopped. If there is concern about possible transfer of communicable diseases through mouth-to-mouth resuscitation, a disposable protective mouthpiece can be used.

F.3.3 Apply cardiopulmonary resuscitation if the heartbeat has stopped.

F.3.4 When poisoning is caused by phosphine, methyl bromide or hydrogen cyanide, mouth-to-mouth resuscitation can be fatal. Use a manual respiratory resuscitating device instead.

F.3.5 On arrival of the medical practitioner,

- a) show him the label of the hazardous substance, if available, or
- b) provide the SDS.

When relevant, submit the work-exposure record card of the patient to the medical practitioner without delay.

F.4 Requirements for medical practitioners and nursing staff

F.4.1 General

An operator could take ill from natural causes while handling dangerous substances, and wrong treatment could make the operator's condition worse. It is therefore important to establish whether a pesticide was actually involved before treatment is given. Contact the supplier of the pesticide for information additional to that given in the SDS or on the pesticide label, if necessary. As soon as the nature of the poison and the route of poisoning (see F.2.2) have been confirmed, carry out the appropriate emergency treatment (which might include the administration of an antidote).

F.4.2 Gastric lavage

If a very toxic pesticide is involved, gastric lavage may be used to empty the stomach, provided that it can be carried out within 4 h of ingestion of the poison. Gastric lavage is, however, contraindicated if a pesticide that contains hydrocarbon solvents or that has corrosive properties has been ingested. Carry out symptomatic and supportive treatment instead.

F.4.3 Induction of vomiting

The induction of vomiting is **not recommended**. However, if the induction of vomiting is indicated on the pesticide label, or if the medical practitioner deems such induction necessary, ensure that the patient is fully conscious. Administer 10 mL to 15 mL of ipecacuanha tincture (BP), followed by a glass of cold water to facilitate emesis. If necessary, follow this treatment with a similar dose after 20 min. After emesis, administer four to five tablets (or one tablespoon) of activated charcoal in a glass of water, followed by a suitable laxative. Follow this with symptomatic and supportive treatment.

F.5 First-aid kit

F.5.1 A first-aid kit shall contain at least the following items:

- a) wound cleaner or antiseptic (100 mL);
- b) swabs for cleaning wounds;
- c) cotton wool for padding (100 g);
- d) sterile gauze swabs (minimum quantity of 10);
- e) 1 pair of forceps (for splinters);
- f) 1 pair of scissors (minimum size 100 mm);
- g) 1 card of safety pins;
- h) bandages:
 - 1) 4 triangular bandages;
 - 2) 4 roller bandages (75 mm × 5 m);
 - 3) 4 roller bandages (100 mm × 5 m); and
 - 4) 1 roll of elastic adhesive bandage (25 mm × 3 m);
- i) adhesive strips:
 - 1) 1 roll of non-allergenic adhesive strip (25 mm × 3 m); and
 - 2) 1 packet of adhesive dressing strips (minimum quantity of 10 assorted sizes);
- j) first-aid dressings:
 - 1) 4 first-aid dressings (75 mm × 100 mm); and
 - 2) 4 first-aid dressings (150 mm × 200 mm);
- k) 2 straight splints;
- l) 2 pairs of large and 2 pairs of medium disposable latex gloves;
- m) 2 cardiopulmonary resuscitation (CPR) mouth-pieces or similar devices; and
- n) an eyewash bottle containing distilled water or rinse solution.

F.5.2 The following items shall be available at the medical station, for use by nursing staff and by medical practitioners:

- a) ipecacuanha tincture (BP);
- b) about 200 g of activated charcoal in powder form or tablet form; and
- c) any special equipment, antidotes, etc., that might be required in view of the specific chemicals to be applied.

F.5.3 Antidotes shall be kept separate from other items.

Annex G

(normative)

Information to be included in an emergency plan

The purpose of an emergency plan is to collect, in one document or file, the essential information that will be needed by the warehouse controller, the fire authority, the police, the traffic authority and other authorities to ensure a rapid and effective response in case of an emergency. The following list is indicative of the type of information that is required; the format in which it is presented and the degree of detail required will vary from warehouse to warehouse. Individuals responsible for preparing an emergency plan are advised to use the list below as a basis, but to supplement it as necessary with additional information obtained from appropriate sources, such as the body of the text of this standard and other publications:

- a) A description, including the address, of the warehouse covered by the plan.
- b) The period of time during which the plan is valid.
- c) Emergency 24-hour contact telephone numbers for key warehouse personnel and organizations such as the fire authority, police, poison information centre, traffic department, civil defence, Department of Water Affairs, Department of Environmental Affairs, ambulance, hospital and doctor.
- d) Names and telephone numbers of external parties (for example chemicals manufacturers, waste disposal specialists and insurers) who may need to be contacted for advice following a fire or a spill.
- e) Safety Data Sheets and sample package labels for each substance in the warehouse.

NOTE Safety Data Sheets cover, under normal circumstances, the symptoms of poisoning, first-aid and protective clothing requirements. However these details may be itemized separately if this would benefit first responders to an emergency.

- f) A sketch map, drawn in accordance with SANS 10143, that shows the site of the warehouse and its immediate surroundings. The north arrow shall be clearly indicated. The map shall incorporate a legend to ensure correct identification of equipment and building components, and shall show the following:
 - 1) outlines of all buildings, type of construction, permanent interior walls, building openings and fixed fire and emergency equipment;
 - 2) elevation views of buildings of more than one storey;
 - 3) the locations of all separating elements and fire-doors, fire-hydrants, sprinkler connections and mains gas and electricity shut-off points;
 - 4) perimeter walls, fences, gates, rail spurs and floor drains;
 - 5) access routes and approximate distances to important buildings;
 - 6) a storage plan that identifies the areas of the building(s) devoted to different classes of substance, such as flammables, oxidizing substances and pesticides;

NOTE In warehouses where the storage layout changes frequently, the storage plan may need to be updated more often than the rest of the emergency plan.

- 7) the location(s) of bulk storage tanks; and
- 8) the location(s) of fuel supply tanks, pumping equipment and air blowers to be used to ensure complete combustion of part or all of the warehouse, should this become necessary;
- g) a sketch map, for run-off control purposes, that shows the surrounding area for 2 km in all directions. The north arrow shall be clearly indicated. The map shall be extended in the direction of site drainage to enable the drainage to be traced until it reaches the nearest large body of water. If run-off can be impounded on site or off site, the map shall show each such location and the approximate volume, in litres, that can be contained. Locations and means of blocking run-off (such as dykes, dams or shutting off of pumps) shall be shown. Surrounding land use (residential, open water) and public assembly places (schools, churches) shall also be shown. The map shall, where possible, be drawn in accordance with SANS 10143. The map shall incorporate a legend to ensure correct identification of important features;
- h) a documented description of the major uses to which the surrounding land is put, for 2 km in each direction (North, South, East, West), to support the sketch maps;
- i) details of the locations of emergency equipment and supplies that are available 24 h a day, other than those detailed on the sketch map in (f) above. For example, the nearest locations from which additional foam stocks, breathing apparatus, earth-moving equipment, portable pumps, sand bags and bulk lime can be obtained, together with telephone numbers, shall be listed;
- j) details, to support the sketch maps in (f) and (g) above, of the locations and types of available water supplies (such as hydrants, ponds, fresh or salt water), in the surrounding area. Details of hydrant coupling compatibility and approximate water pressure and flow rates shall also be given;
- k) post-fire and post-spill clean-up instructions, such as:
 - 1) instructions for the isolation and security of the scene until the clean-up has been completed;
 - 2) details, including telephone numbers, of the person who will be in charge of clean-up operations, of toxic waste or demolition contractors, and of national or local health, water or environmental authorities that are to be contacted for disposal instructions or for approval (or both);
 - 3) local sources of supply of protective clothing, respirators, earth-moving equipment, and bulk chemicals (such as lime);
 - 4) instructions as to where contaminated firefighting equipment and protective clothing are to be placed or impounded and how they are to be decontaminated or disposed of;
 - 5) instructions for decontamination of firefighters and other persons who have come into contact with dangerous goods;
 - 6) the symptoms of poisoning to be on the lookout for among personnel who have been exposed to dangerous goods, once they have left the scene; and
 - 7) an indication of the "base-level" borehole water and soil analyses in the area;

NOTE These will assist in determining the extent to which contamination has occurred, and the extent of cleaning up that will be required.

- l) documented authority that will enable the person in charge of operations at the time of a fire to make the decision to allow a warehouse, or an area of a warehouse, to burn, when the determines that continued water application
 - 1) will result in extensive contaminated water run-off, or
 - 2) could result in incomplete combustion of chemicals, or
 - 3) could result in a release of toxic compounds into the air, or
 - 4) is likely to otherwise endanger the lives of firefighters or the environment (or both).

In this regard unambiguous authority should be given in advance by the warehouse controller to the fire authority to allow a facility to burn when deemed necessary; warehouse controllers are, however, advised to negotiate the financial consequences of this eventuality with their insurers in advance.

Annex H

(informative)

Competent authority designation

1	2
Description of dangerous goods	Competent authority
Explosives (see 12.8.2.2)	<p>The Chief Inspector of Explosives Private Bag X624 PRETORIA 0001</p> <p>Telephone : (012) 328-4900 Fax : (012) 323-4282</p>
Radioactive material (see 12.8.10)	<p>The Executive Officer The Council for Nuclear Safety PO Box 7106 HENNOPSMEER 0046</p> <p>Telephone : (012) 663-5500 Fax : (012) 663-5513</p>
	<p>The Directorate: Health Technology Department of Health Private Bag X62 BELLVILLE 7535</p> <p>Telephone : (021) 948-6162 Fax : (021) 946-1589</p>
	<p>The Senior Manager Licensing and Safeguards Atomic Energy Corporation of SA Ltd PO Box 582 PRETORIA 0001</p> <p>Telephone : (012) 316-5618 Fax : (012) 316-5140</p>

Bibliography

Standards

SANS 275/ EN 12083; *Respiratory protective devices – Filters with breathing hoses, (Non-mask mounted filters) – Particle filters, gas filters, and combined filters – Requirements, testing, marking.*

SANS 310-1, *Storage tank facilities for hazardous chemicals – Part 1: Above-ground storage tank facilities for non-flammable chemicals.*

SANS 951, *Fire-resistant record protection equipment.*

SANS 1485, *Flexible intermediate bulk containers.*

SANS 10019 , *Transportable containers for compressed, (dissolved and liquefied) gases – Basic design, manufacture, use and maintenance.*

SANS 10087-1, *The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 1: Liquefied petroleum gas installations involving gas storage containers of individual water capacity not exceeding 500 L and a combined water capacity not exceeding 3 000 L per installation.*

SANS 10087-2 (SABS 087-2), *The handling, storage, and distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 2: Installations in mobile units and small non-permanent buildings.*

SANS 10087-3, *The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 3: Liquefied petroleum gas installations involving storage vessels of individual water capacity exceeding 500 L.*

SANS 10087-4 (SABS 087-4), *The handling, storage, and distribution of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 4: Transportation of LPG in bulk by road.*

SANS 10087-6, *The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial, and industrial installations – Part 6: The application of liquefied petroleum and compressed natural gases as engine fuels for internal combustion engines.*

SANS 10087-7, *The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial and industrial installations – Part 7: Storage and filling premises for refillable liquefied petroleum gas (LPG) containers of gas capacity not exceeding 9 kg and the storage of individual gas containers not exceeding 48 kg.*

SANS 10087-8 (SABS 087-8), *The handling, storage, distribution and maintenance of liquefied petroleum gas in domestic, commercial and industrial installations – Part 8: The fuelling of fork lift trucks and other LP gas operated vehicles.*

SANS 10089-1, *The petroleum industry – Part 1: Storage and distribution of petroleum products in above-ground bulk installations.*

SANS 10131, *Above-ground storage tanks for petroleum products.*

SANS 10177-5, *Fire testing of materials, components, and elements used in buildings – Part 5: Non-combustibility at 750 °C of building materials.*

SANS 10220, *The selection, use and maintenance of respiratory protective equipment.*

SANS 10263-0:2010

Edition 1.1

SANS 50141/EN 141, *Respiratory protective devices – Gas filters and combined filters – Requirements, testing, marking.*

SANS 50143/EN 143, *Respiratory protective devices – Particle filters – Requirements, testing, marking.*

Other publications

A guide to safe warehousing for the European chemical industry. Centre européen des fédérations de l'industrie chimique. Brussels: CEFIC, 1987.

Awareness and preparedness for emergencies at local level. Paris: United Nations Environment Programme: Industry and Environment Office, 1988.

Brandschutz in Pflanzenschutz-mittelagern. Frankfurt am Main: Industrieverband Pflanzenschutz E.V., 1986.

Chlorine safety pays: An overview of hazards and safe practices. World Environment Centre. New York: World Environment Center, 1988.

Fire protection handbook. National Fire Protection Association. Edited by GP McKinnon and K Tower. 14th ed. Boston: NFPA, 1976.

Fire protection in warehouses and storage: European guide to warehouse safety. Fire Protection Association. London: FPA, 1986.

Guidelines for safe warehousing of pesticides. Groupement International des Associations Nationales de Fabricants de Produits Agrochimiques. Brussels: GIFAP, 1988

Guidelines for safe warehousing of substances with hazardous characteristics. Chemical Industries Association. London: Chemical Industries Association, 1983.

Guidelines for the design, installation and operation of incinerators. United Kingdom. Department of Health. London: HMSO, 1994.

Handling chemicals safely. Dutch Chemical Industry Association. Amsterdam: Dutch Chemical Industry Association, 1980.

Holme, I. *The provision, storage and handling of dyes and chemicals for textile dyeing, printing and finishing.* United Nations Industrial Development Organization, 1980.

International maritime dangerous goods code. International Maritime Organisation. Consolidated edition. London: I.M.O.

Manual: Warehousing. Leverkusen: Bayer AG, 1989.

Manufacture and storage of aerosol products. National Fire Protection Association. Quincy: NFPA, 1990. ANSI/NFPA 30B.

Minimum requirements for monitoring at waste management facilities. vol. 1. South Africa. Department of Water Affairs and Forestry. Pretoria: Government Printer, 1994.

Minimum requirements for waste disposal by landfill. vol. 1. South Africa. Department of Water Affairs and Forestry. Pretoria: Government Printer, 1994.

Recommendations of the transport of dangerous good – Model Regulations. 15th rev. ed. New York and Geneva, 2007.

Safe storage of crop protection. UK: Imperial Chemical Industries: Agrochemicals Business, Safety and Health Standards.

Sims, ER. *Safety store, hazardous and flammable materials.* *Chemical Engineering*, 28 September 1987, p. 129-132.

Storage of hazardous materials: a technical guide for safe warehousing of hazardous materials. United Nations Environment Programme. Paris: UNEP Industry and Environment Office, 1990.

Stowage & segregation guide to the IMDG-code. Hamburg: Storck Verlag. ISBN 3-923190-15-8.

The Shell guide to the warehousing of chemicals. Shell International Chemical Company. London: Shell International Chemical Company, 1987.

© SABS

This page has been left blank intentionally

SABS – Standards Division

The objective of the SABS Standards Division is to develop, promote and maintain South African National Standards. This objective is incorporated in the Standards Act, 2008 (Act No. 8 of 2008).

Amendments and Revisions

South African National Standards are updated by amendment or revision. Users of South African National Standards should ensure that they possess the latest amendments or editions.

The SABS continuously strives to improve the quality of its products and services and would therefore be grateful if anyone finding an inaccuracy or ambiguity while using this standard would inform the secretary of the technical committee responsible, the identity of which can be found in the foreword.

Tel: +27 (0) 12 428 6666 Fax: +27 (0) 12 428 6928

The SABS offers an individual notification service, which ensures that subscribers automatically receive notification regarding amendments and revisions to South African National Standards.

Tel: +27 (0) 12 428 6883 Fax: +27 (0) 12 428 6928 E-mail: sales@sabs.co.za

Buying Standards

Contact the Sales Office for South African and international standards, which are available in both electronic and hardcopy format.

Tel: +27 (0) 12 428 6883 Fax: +27 (0) 12 428 6928 E-mail: sales@sabs.co.za

South African National Standards are also available online from the SABS website <http://www.sabs.co.za>

Information on Standards

The Standards Information Centre provides a wide range of standards-related information on both national and international standards, and is the official WTO/TBT enquiry point for South Africa. The Centre also offers an individual updating service called INFOPLUS, which ensures that subscribers automatically receive notification regarding amendments to, and revisions of, international standards.

Tel: +27 (0) 12 428 6666 Fax: +27 (0) 12 428 6928 E-mail: info@sabs.co.za

Copyright

The copyright in a South African National Standard or any other publication published by the SABS Standards Division vests in the SABS. Unless exemption has been granted, no extract may be reproduced, stored in a retrieval system or transmitted in any form or by any means without prior written permission from the SABS Standards Division. This does not preclude the free use, in the course of implementing the standard, of necessary details such as symbols, and size, type or grade designations. If these details are to be used for any purpose other than implementation, prior written permission must be obtained.

Details and advice can be obtained from the Senior Manager.

Tel: +27 (0) 12 428 6666 Fax: +27 (0) 12 428 6928 E-mail: info@sabs.co.za